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(54) Title of the invention: Forming a wellbore casing while simultaneously drilling a wellbore

(51) Int Cl^7: **E21B** 7/20 33/14 43/10

(21) Application No: 0310118.5

(22) Date of Filing: 06.03.2000

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(43) Date A Publication: 27.08.2003

(52) UK CL (Edition V):
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(56) Documents Cited:
GB 2347445 A WO 2000/077431 A

(58) Field of Search:
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UK CL (Edition V) **E1F** FCM
INT CL^7 **E21B**
Other: **Online: WPI, EPODOC, JAPIO**
updated as appropriate

(72) Inventor(s):
Robert Lance Cook
David Paul Brisco
R Bruce Stewart
Lev Ring
Richard Carl Haut
Robert D Mack
Alan B Duell

(73) Proprietor(s):
Shell Internationale Research Maatschappij B.V.
(Incorporated in the Netherlands)
Department IP/43 Carel Van Bylandtlaan 30, 2596 HR The Hague, Netherlands

(74) Agent and/or Address for Service:
Haseltine Lake & Co
Imperial House, 15-19 Kingsway, LONDON, WC2B 6UD, United Kingdom

2385623

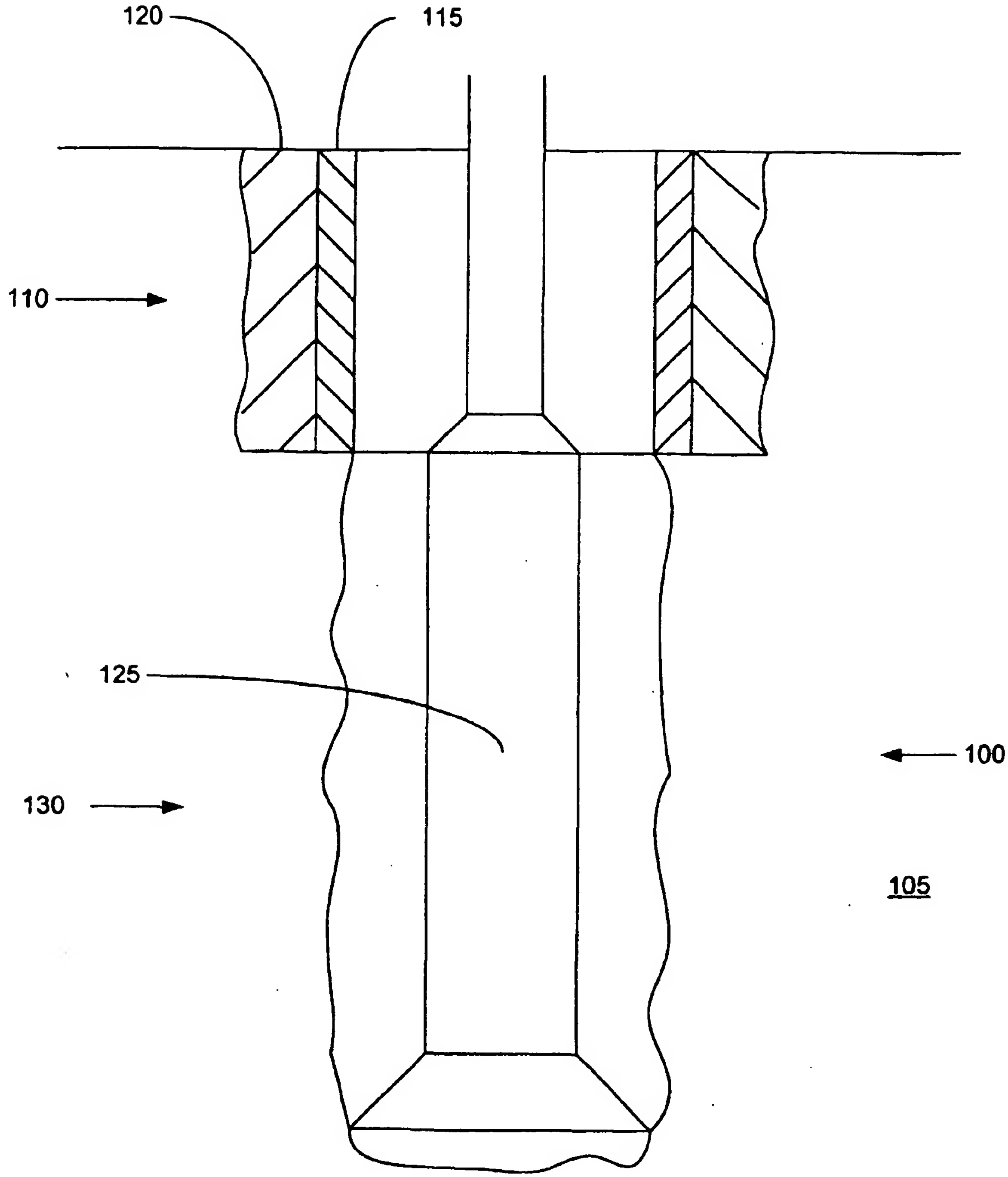

FIGURE 1

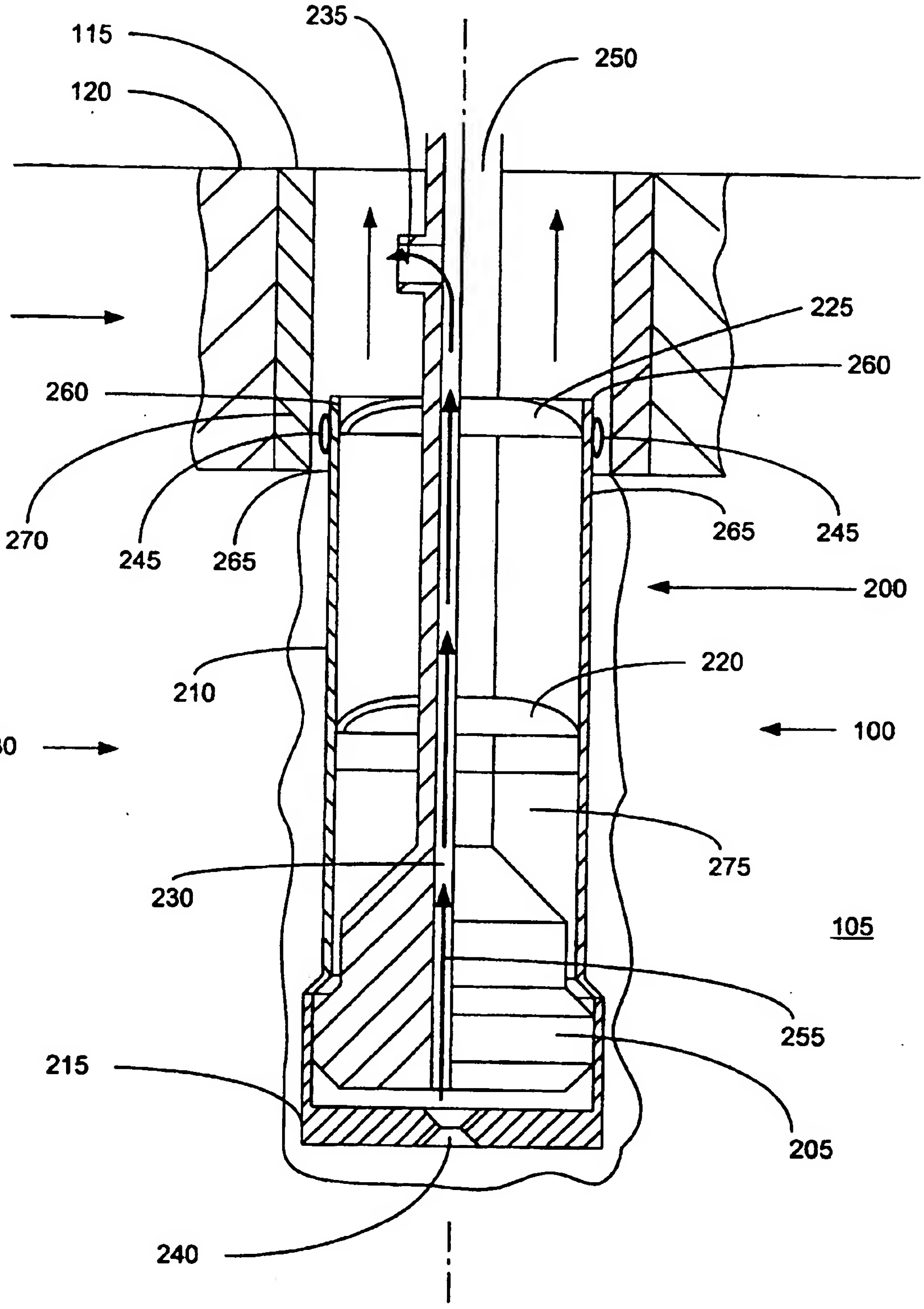
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FIGURE 2

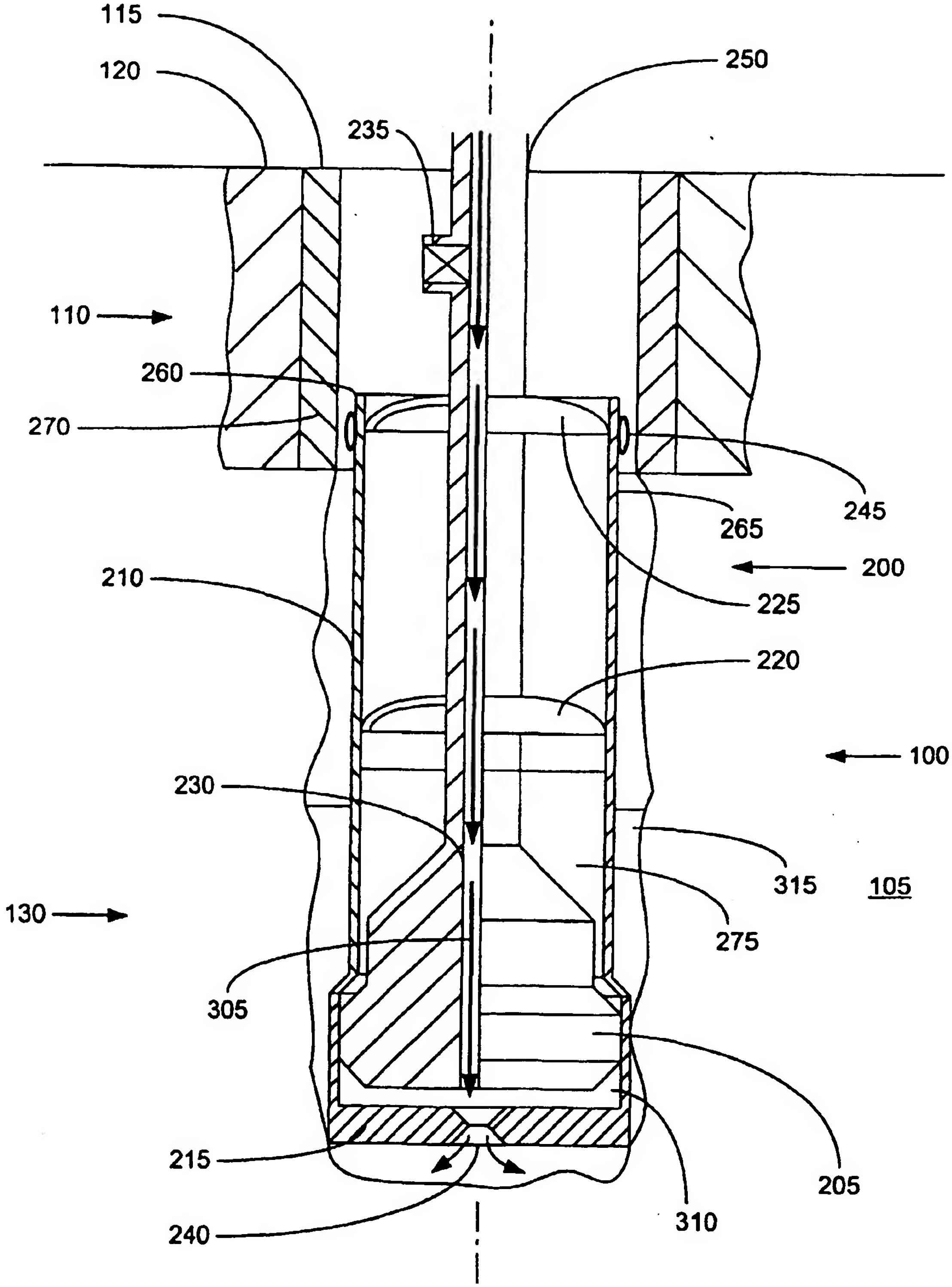
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FIGURE 3

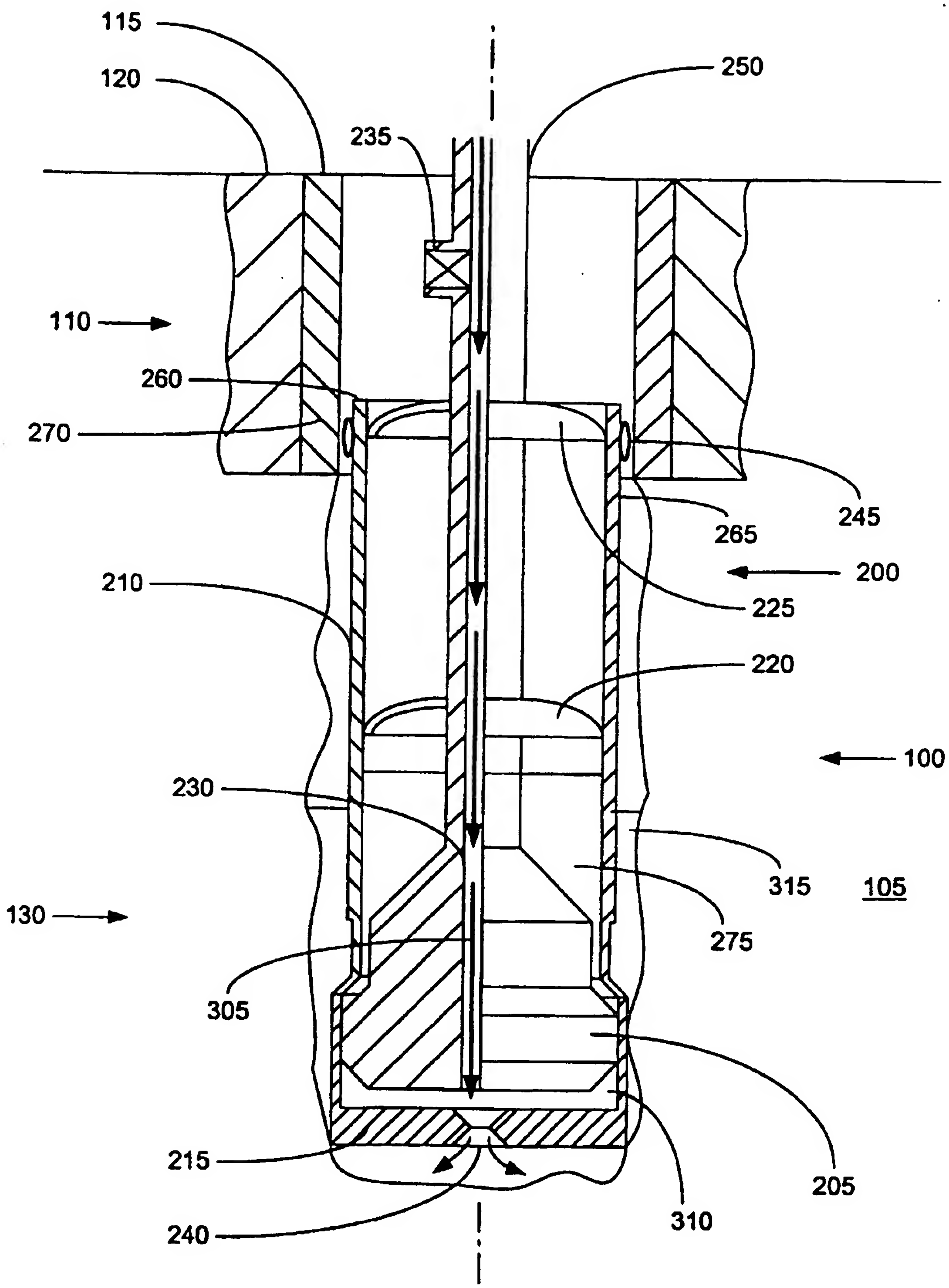
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FIGURE 3a

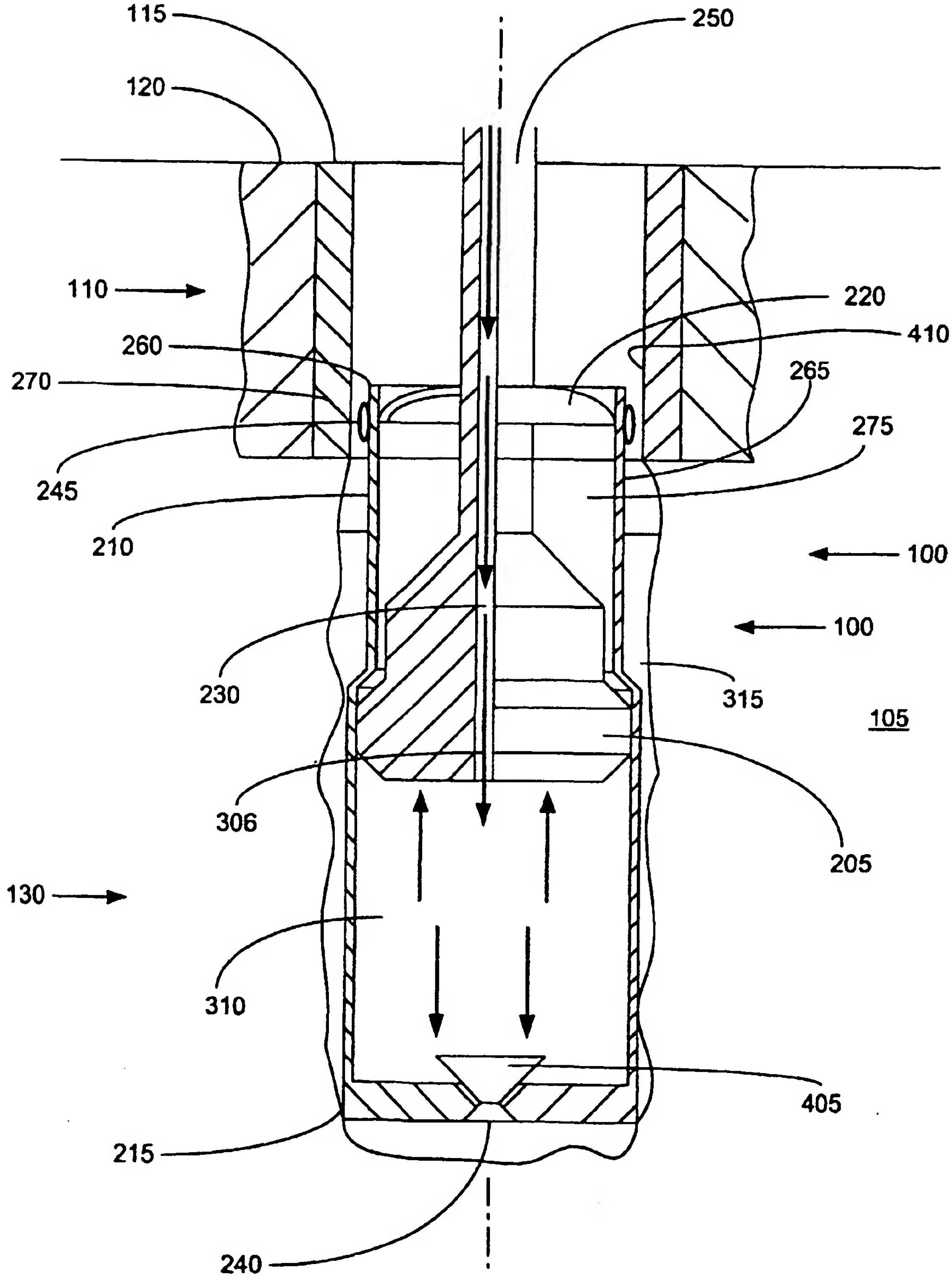
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FIGURE 4

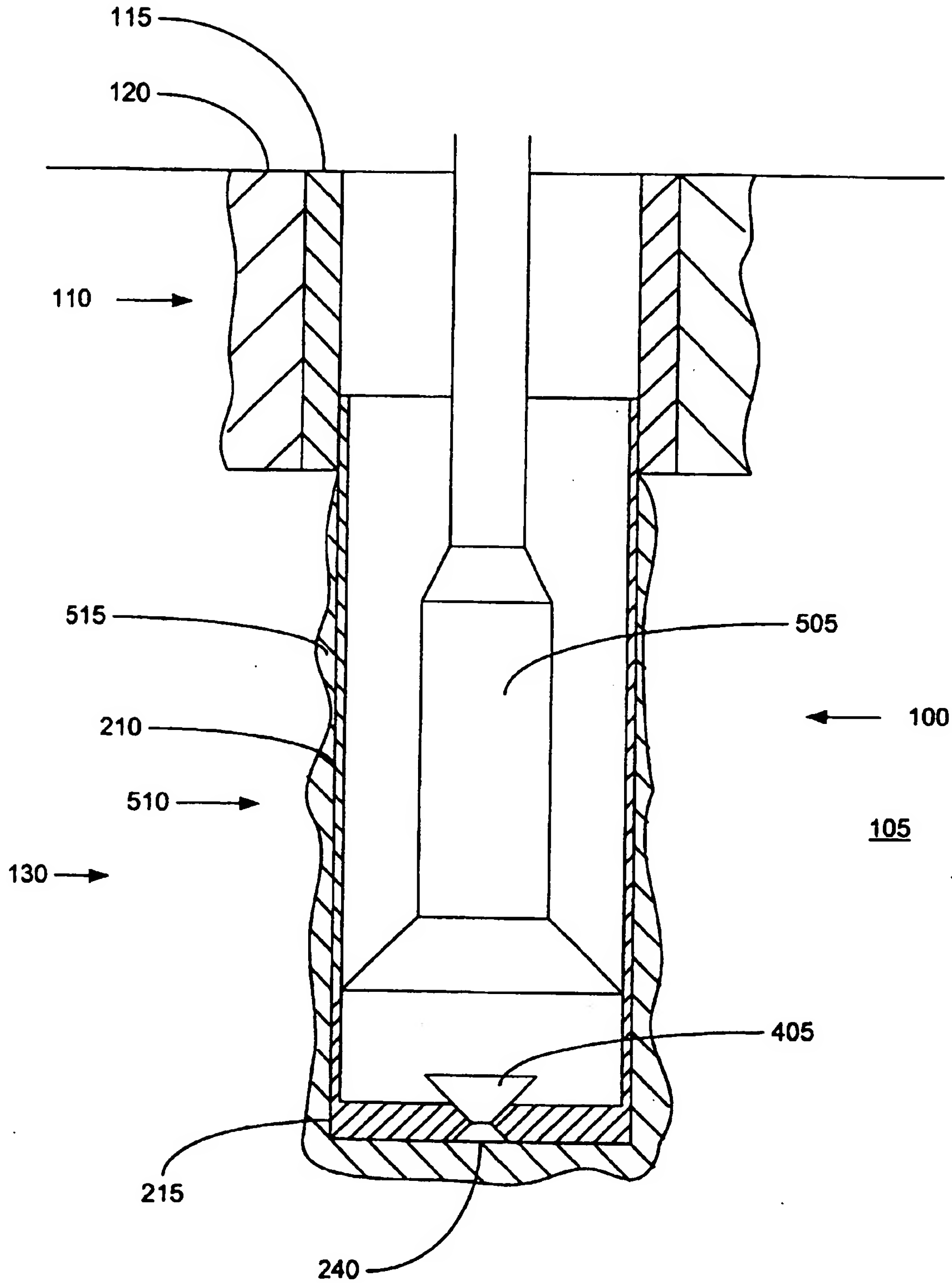


FIGURE 5

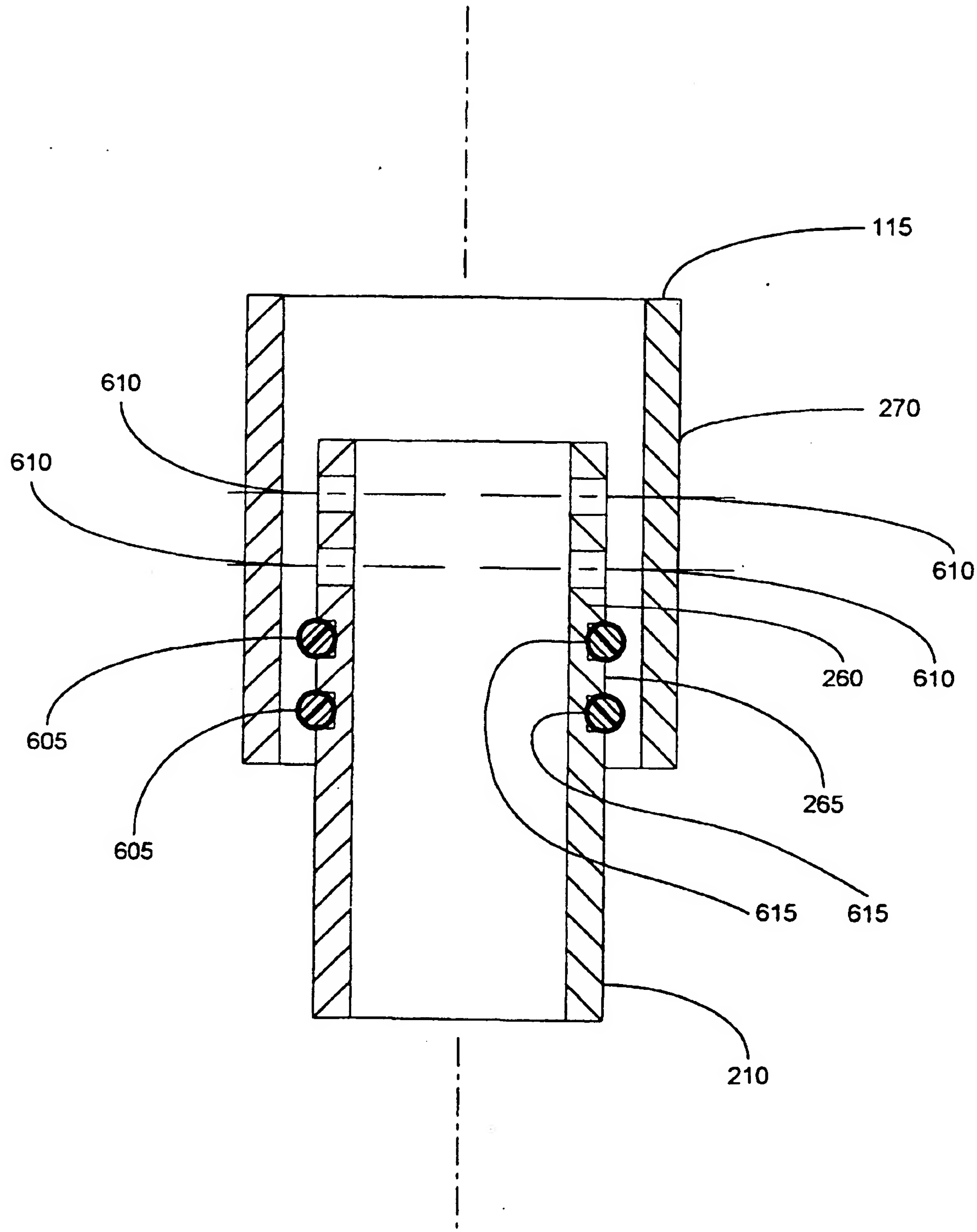
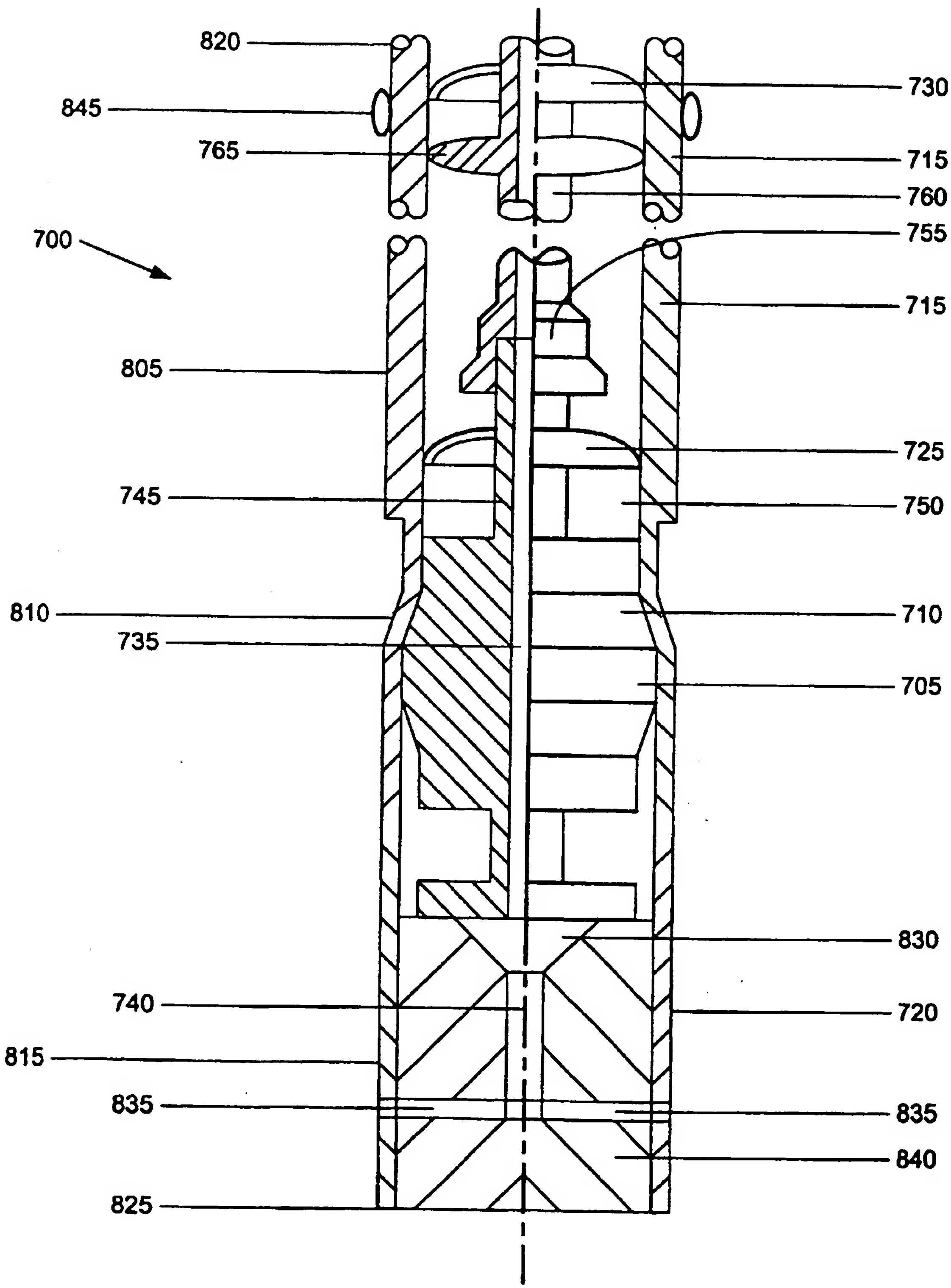


FIGURE 6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710
705
830
720
835
840

FIGURE 7

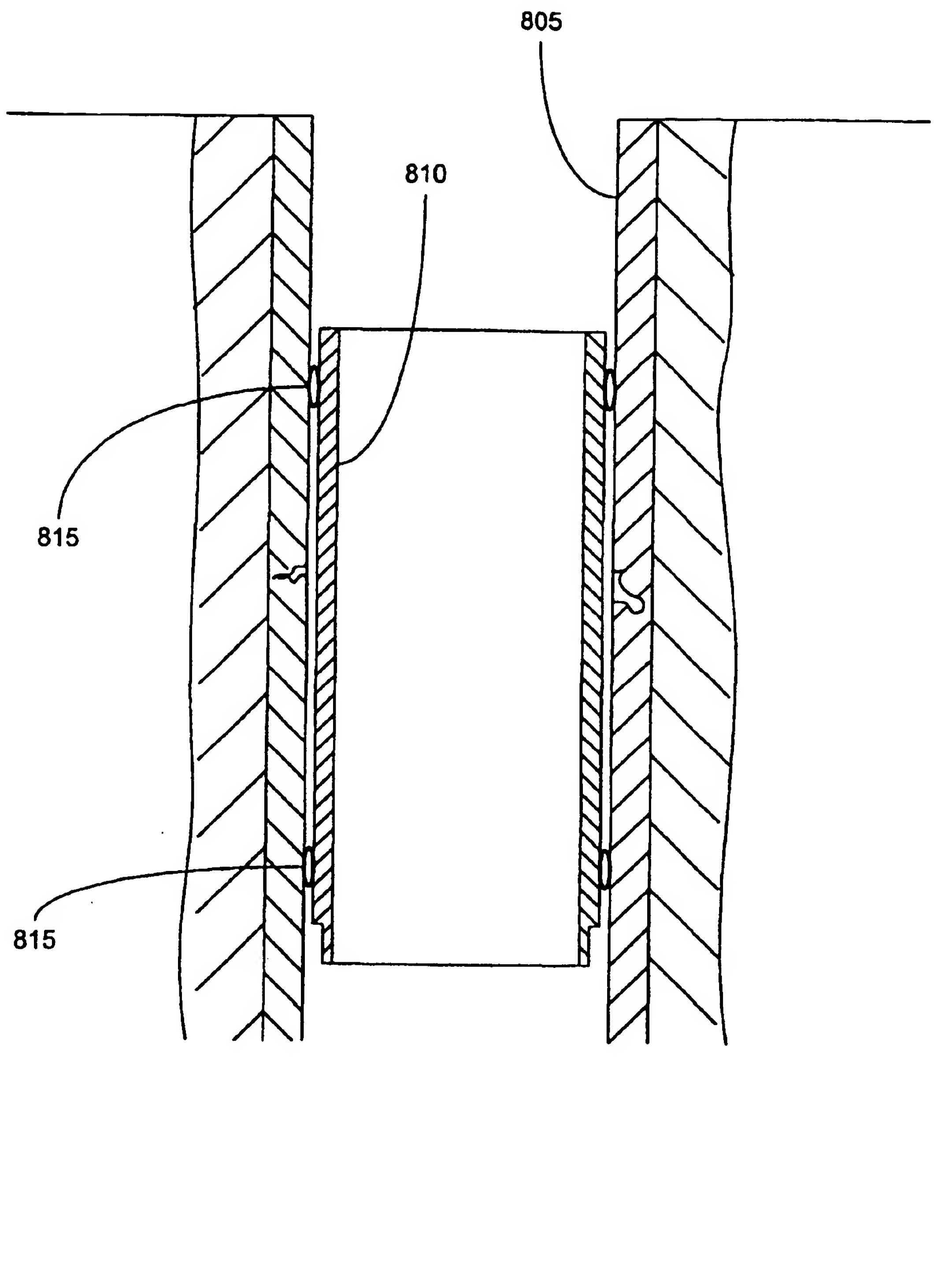
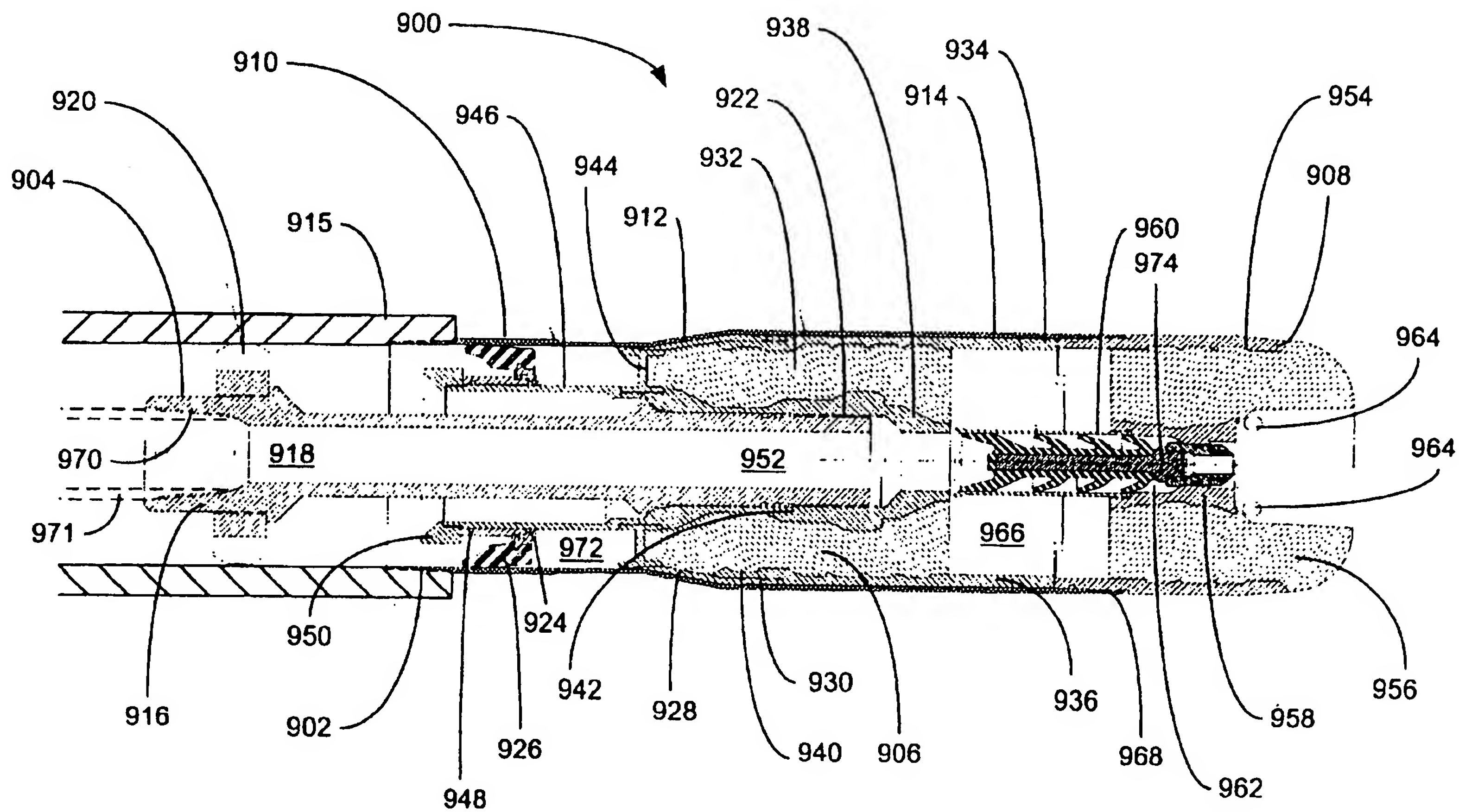


FIGURE 8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964
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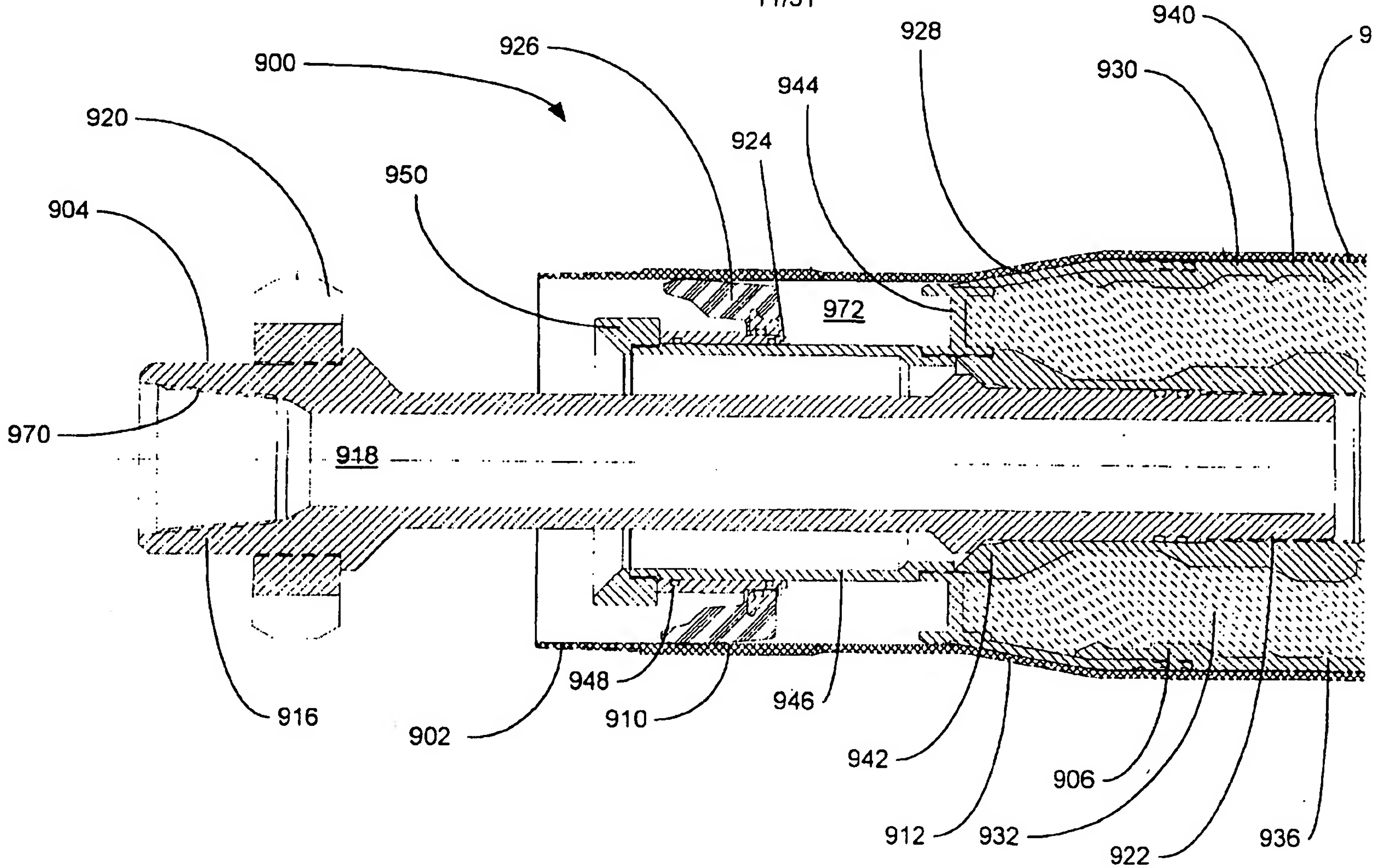
956

FIGURE 9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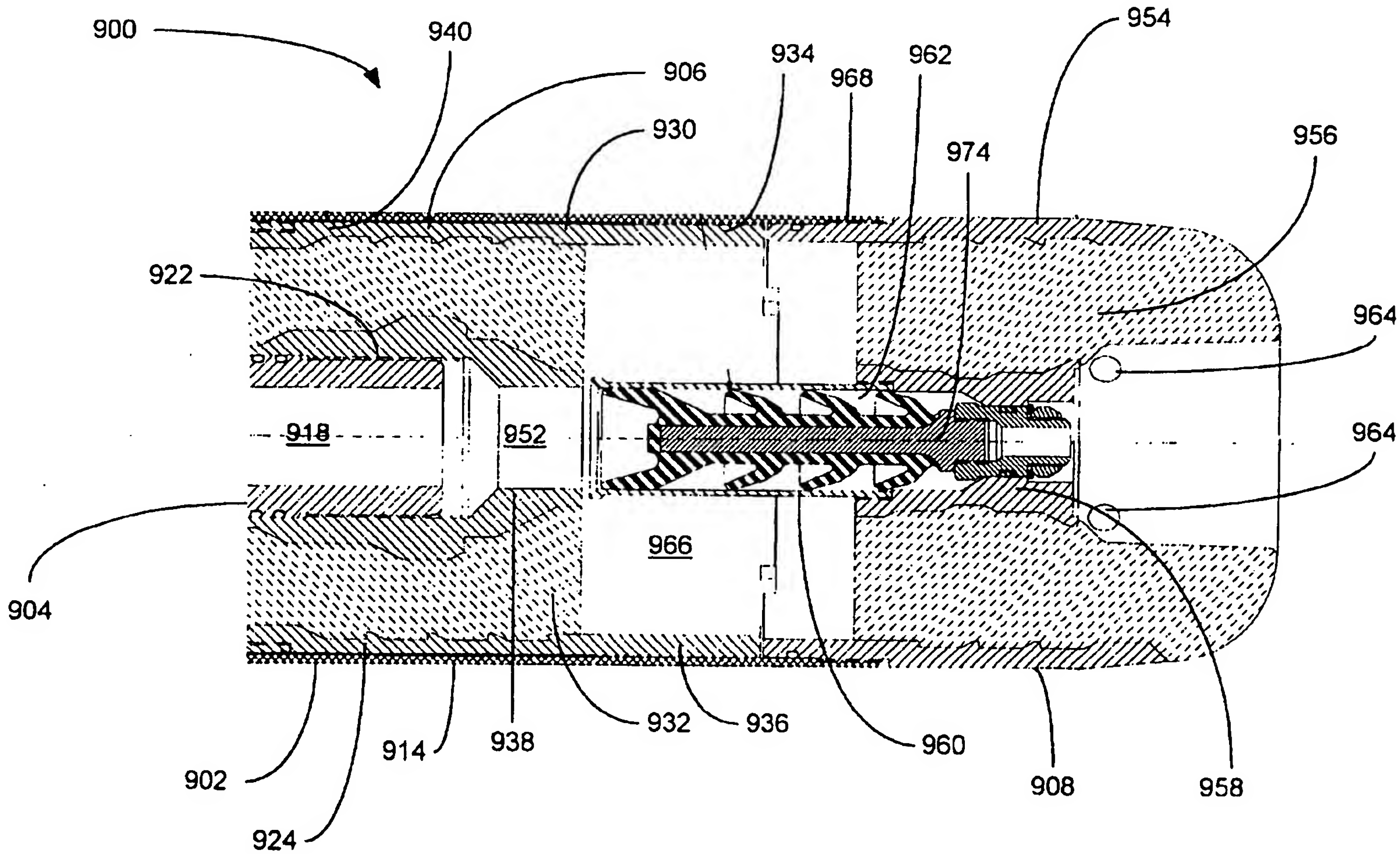
936

FIGURE 9a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960
908
958

FIGURE 9b

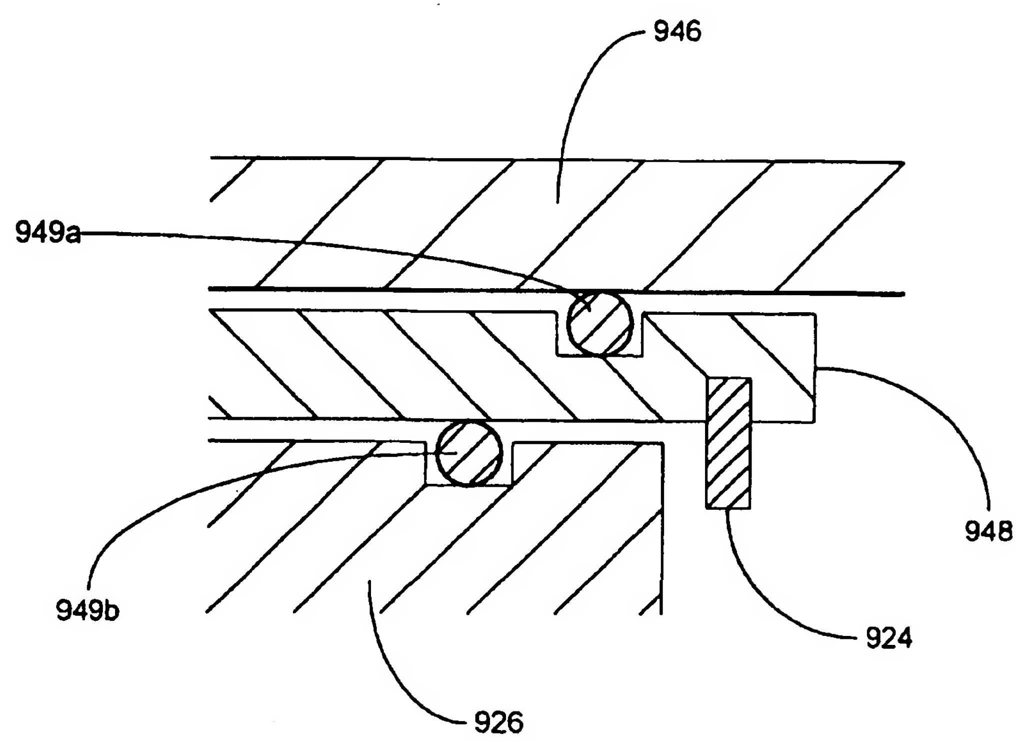


FIGURE 9C

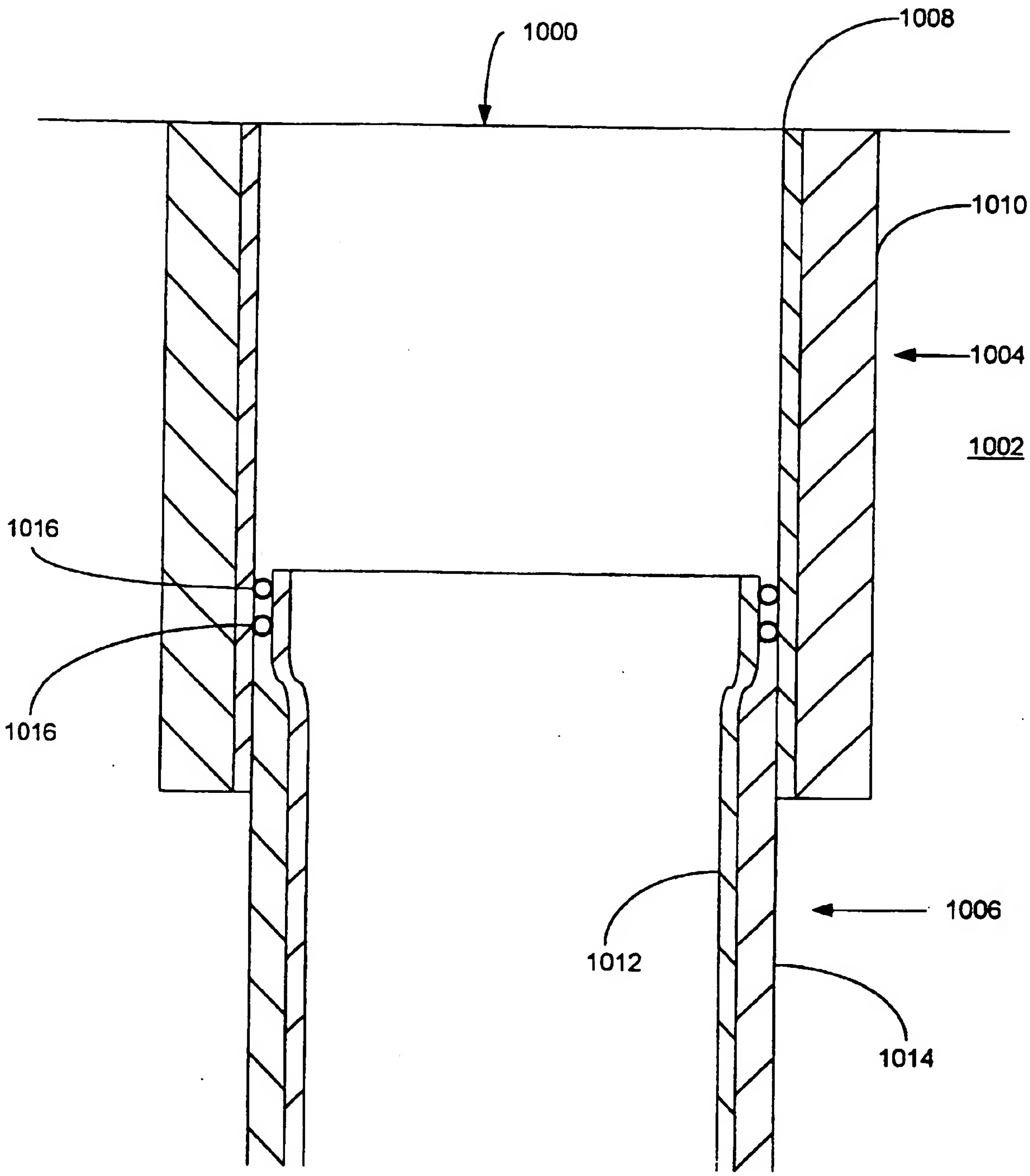
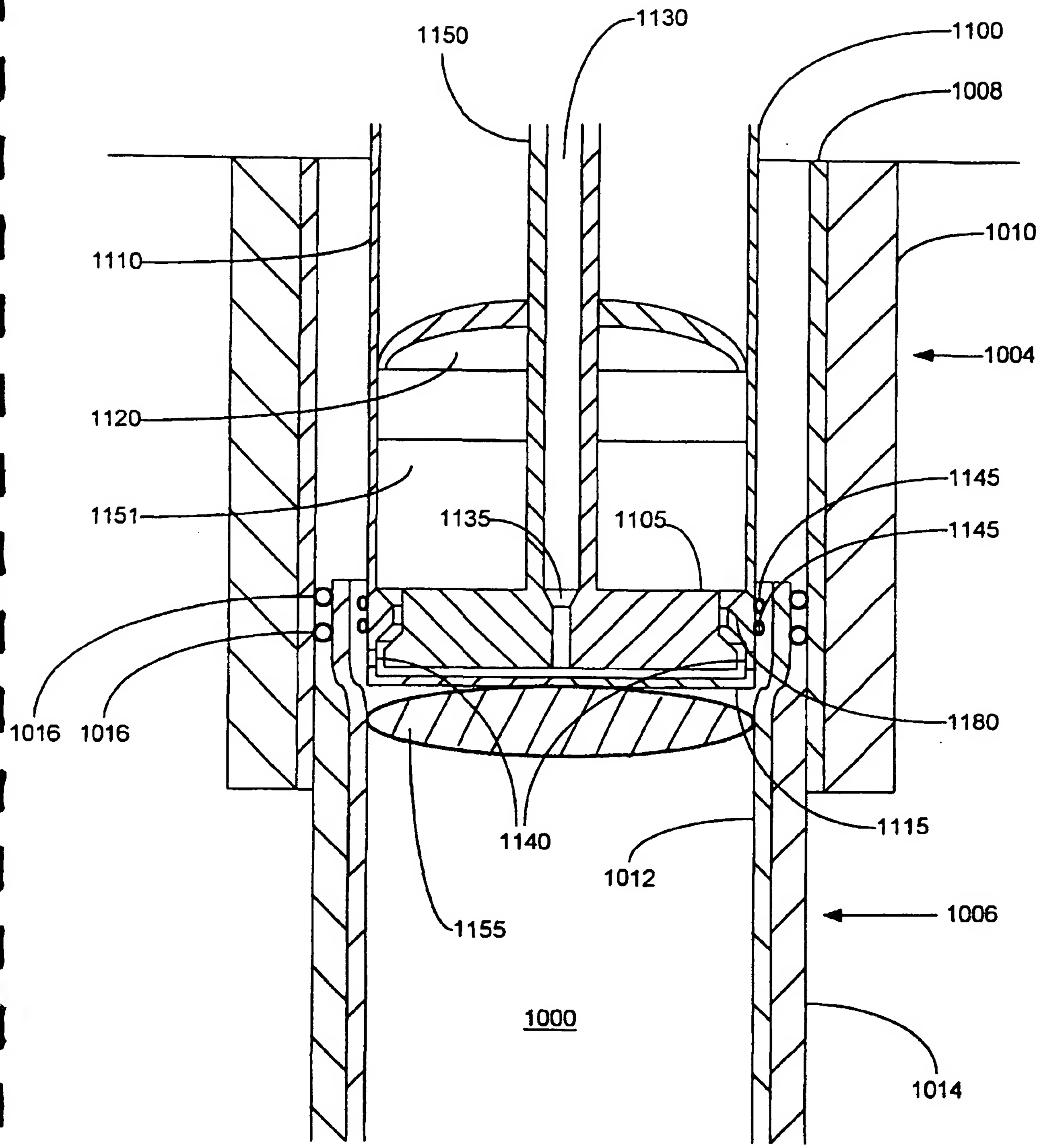


FIGURE 10a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1004
1120
1151
1145
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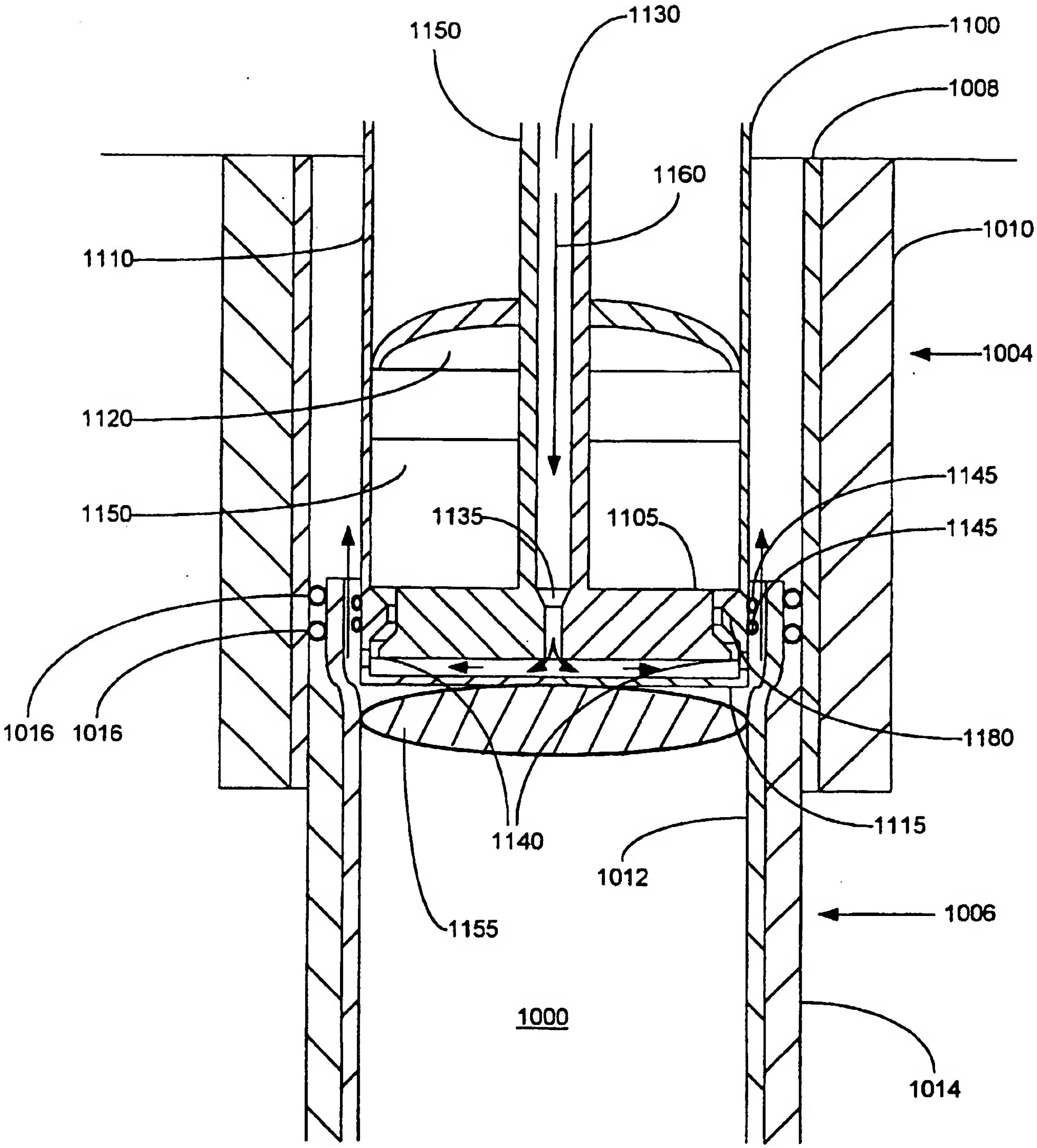
1105
1145
1016
1016
1180
1140
1115
1012
1155
1006
1000
1014

FIGURE 10b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1004
1120
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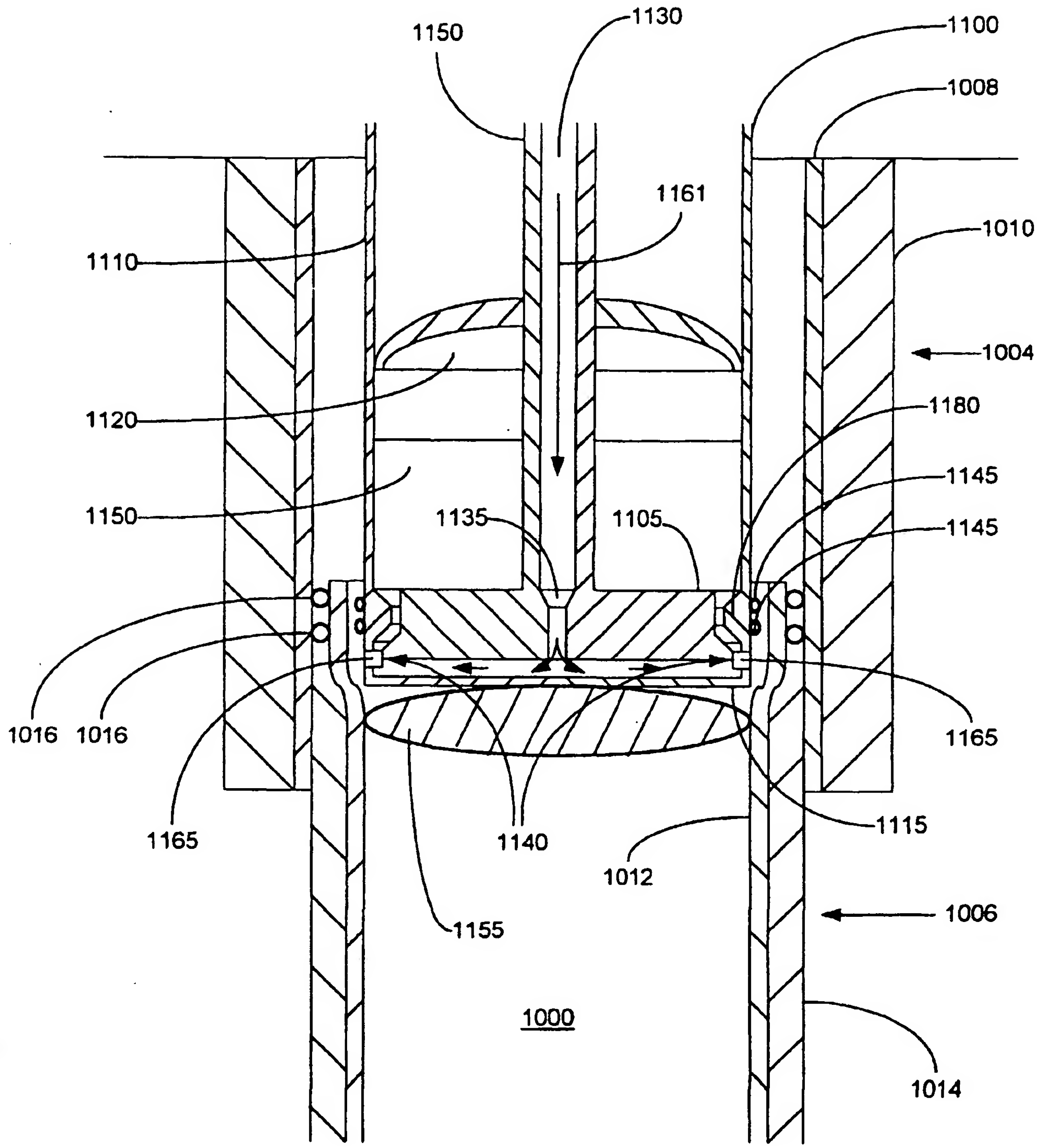
1105
1145
1016
1016
1180
1140
1115
1012
1155
1006
1000
1014

FIGURE 10c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1150
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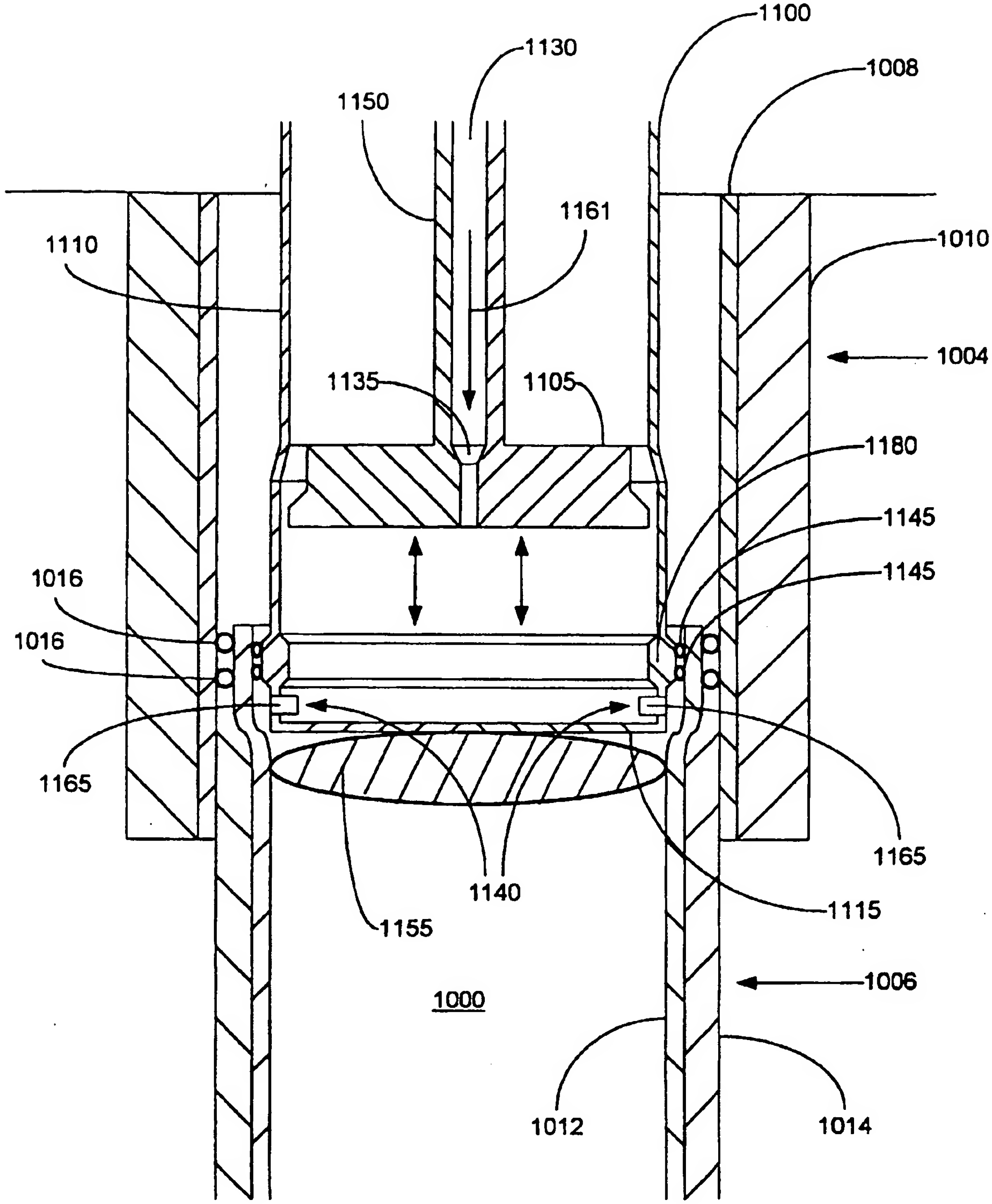
1145
1016
1016
1165
1165
1140
1115
1012
1155
1006
1000
1014

FIGURE 10d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1004
1135
1105
1180
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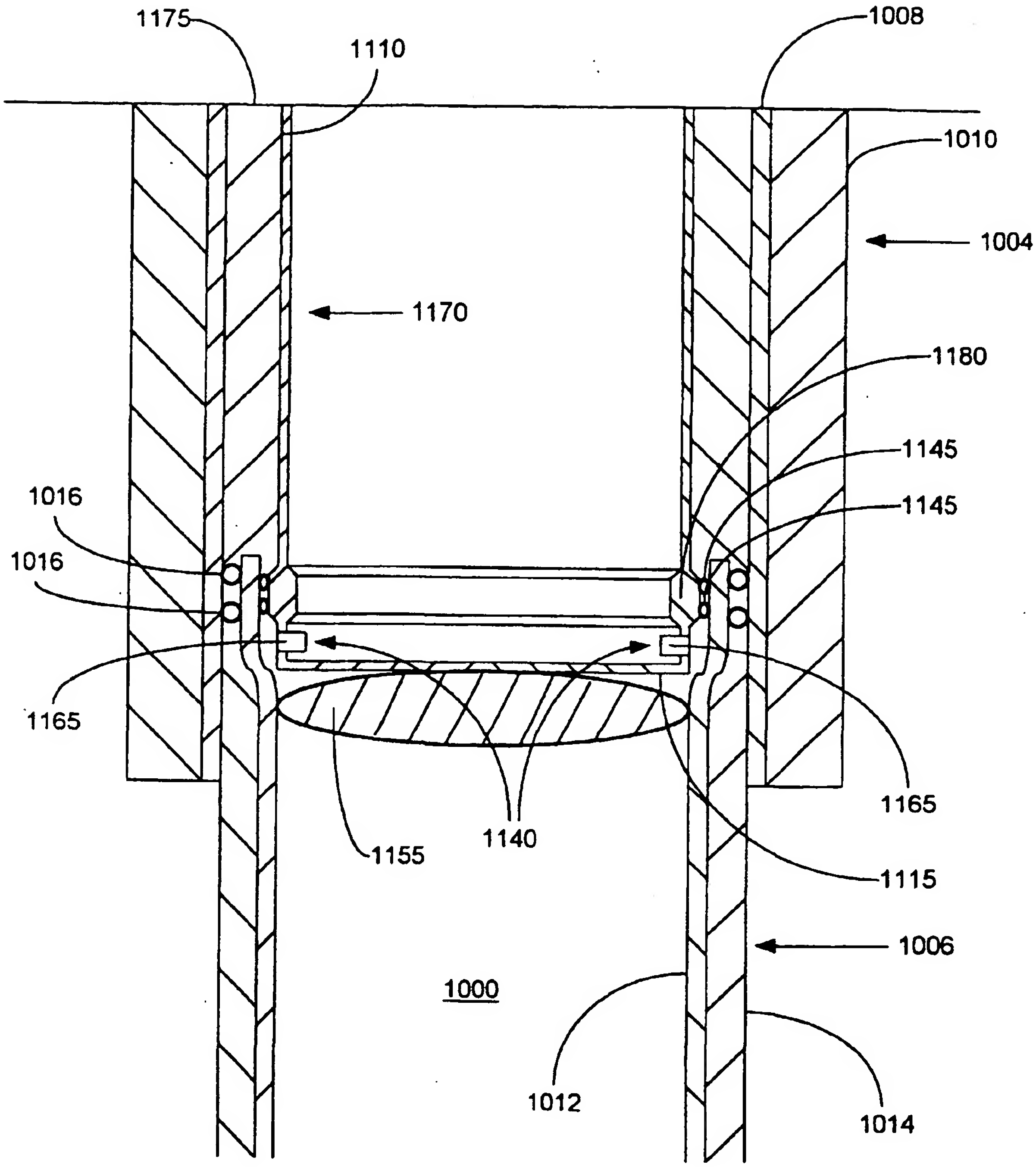
1145
1016
1016
1165
1165
1140
1115
1155
1006
1000
1012
1014

FIGURE 10e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1016
1016
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1165
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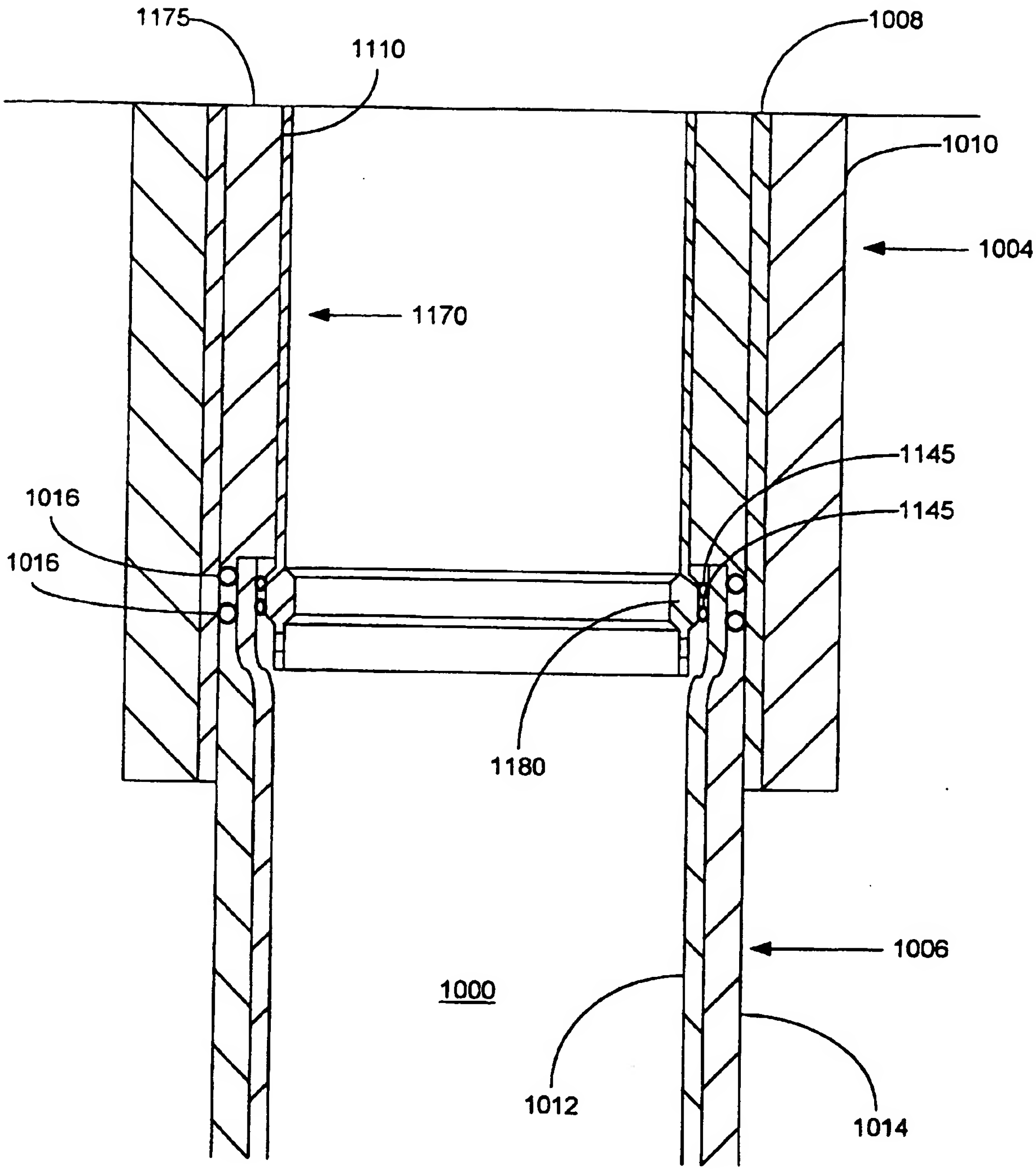
1155
1115
1006
1000
1012
1014

FIGURE 10f



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1110
1008
1010
1004
1170
1145
1145
1016
1016
1180
1006
1000
1012
1014

FIGURE 10g

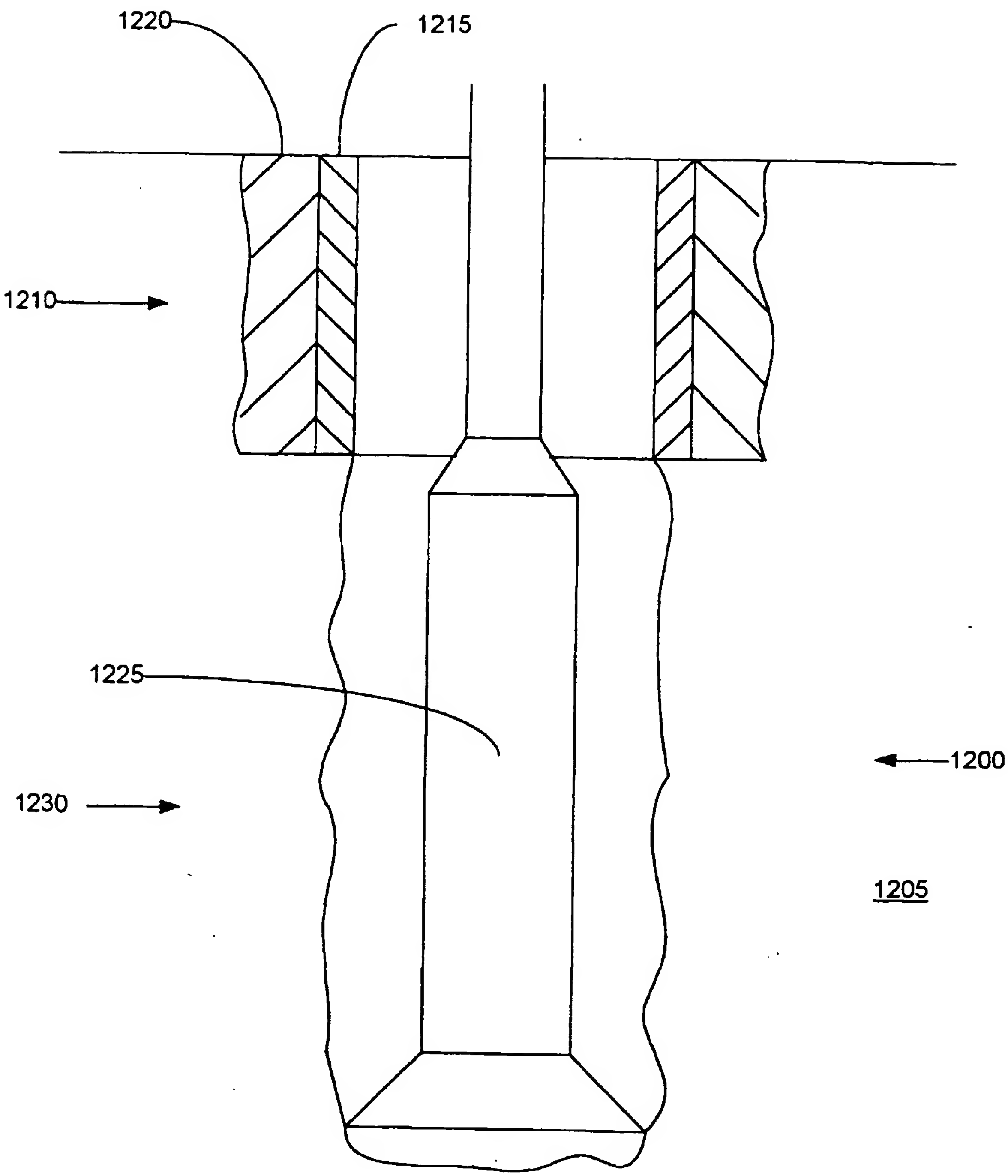
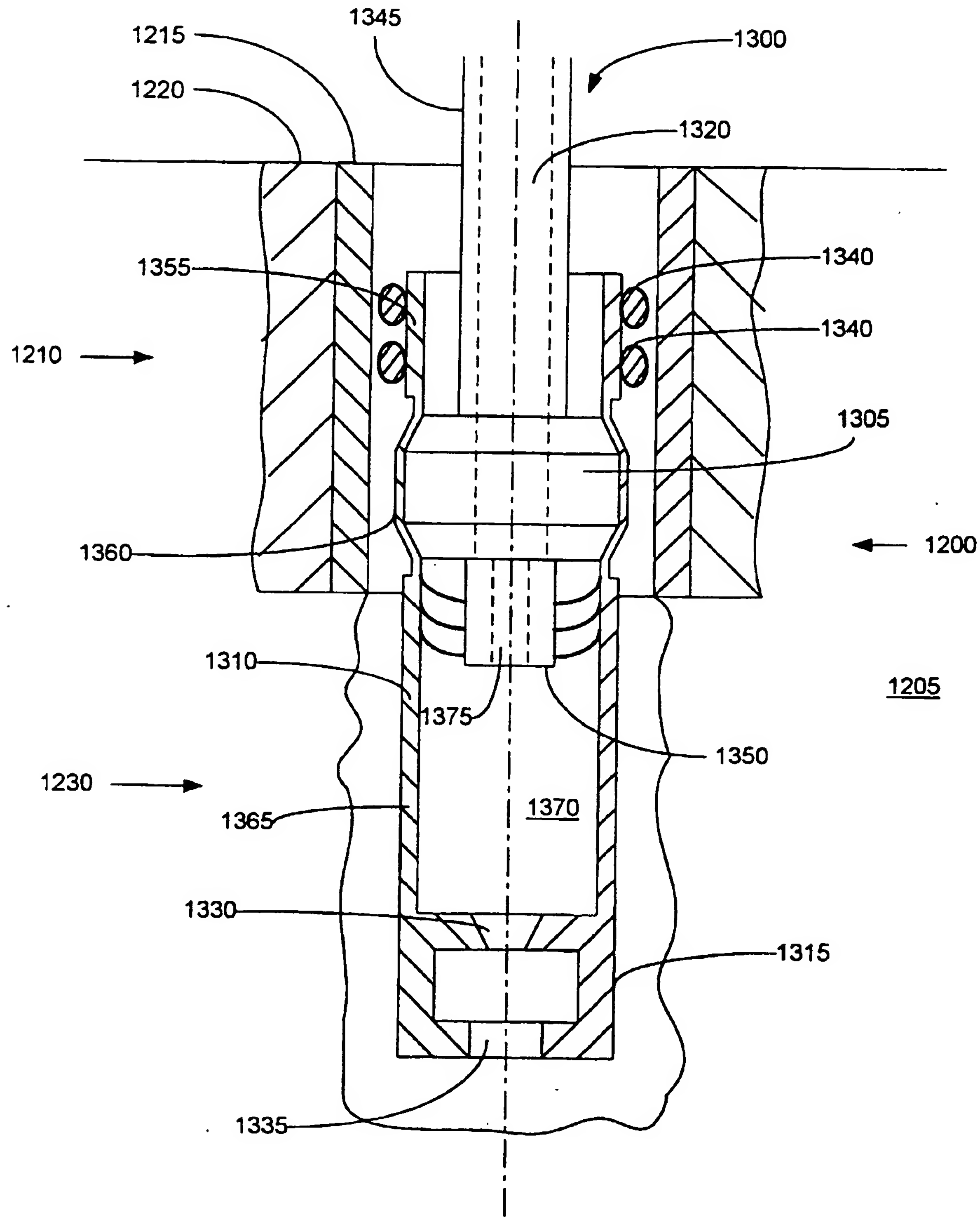


FIGURE 11a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1300
1220
1320
1355
1340
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1305
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1200
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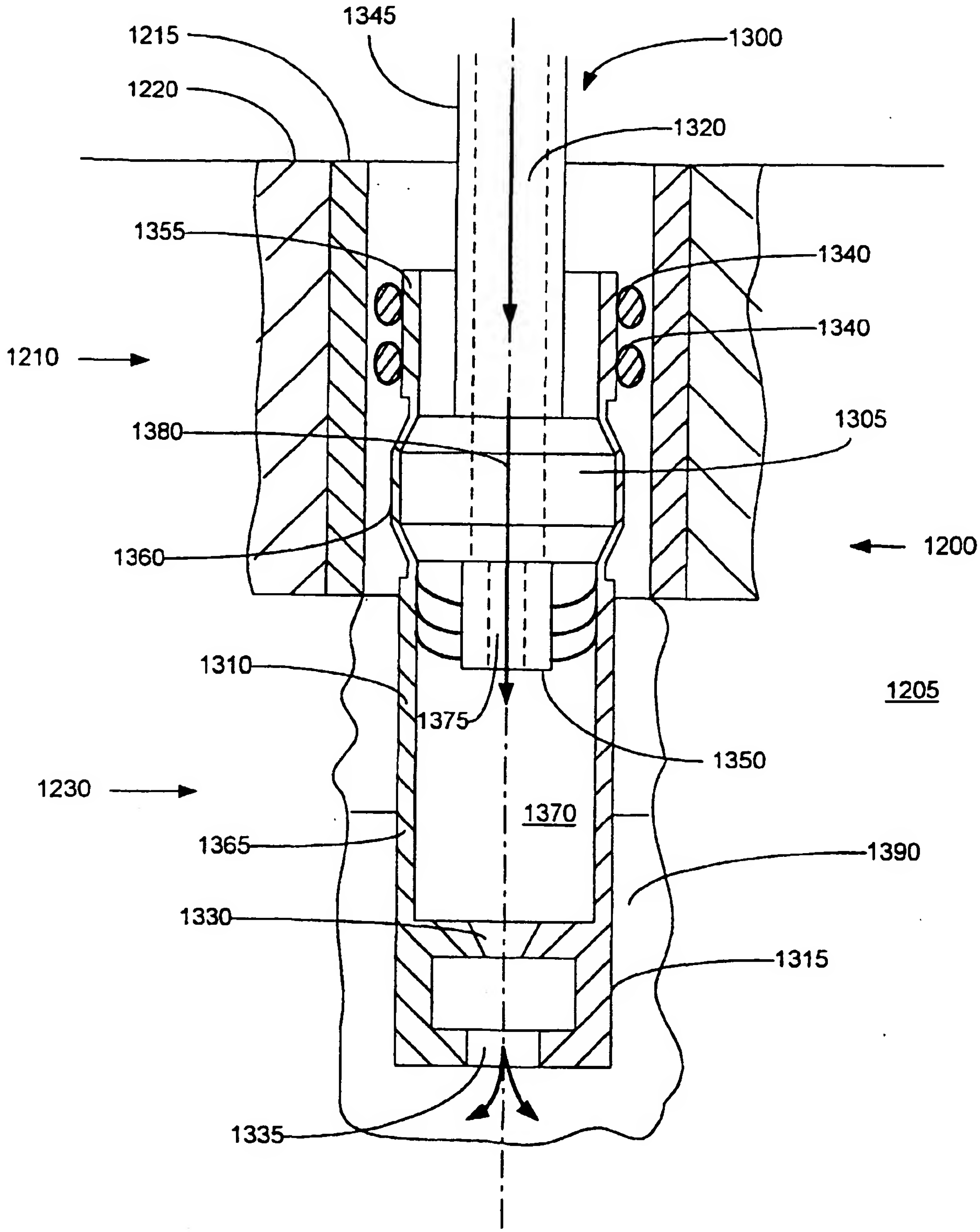
1205
1375
1350
1230
1370
1365
1330
1315
1335

FIGURE 11b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1320
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1340
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1305
1380
1360
1200
1310
1205
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1350
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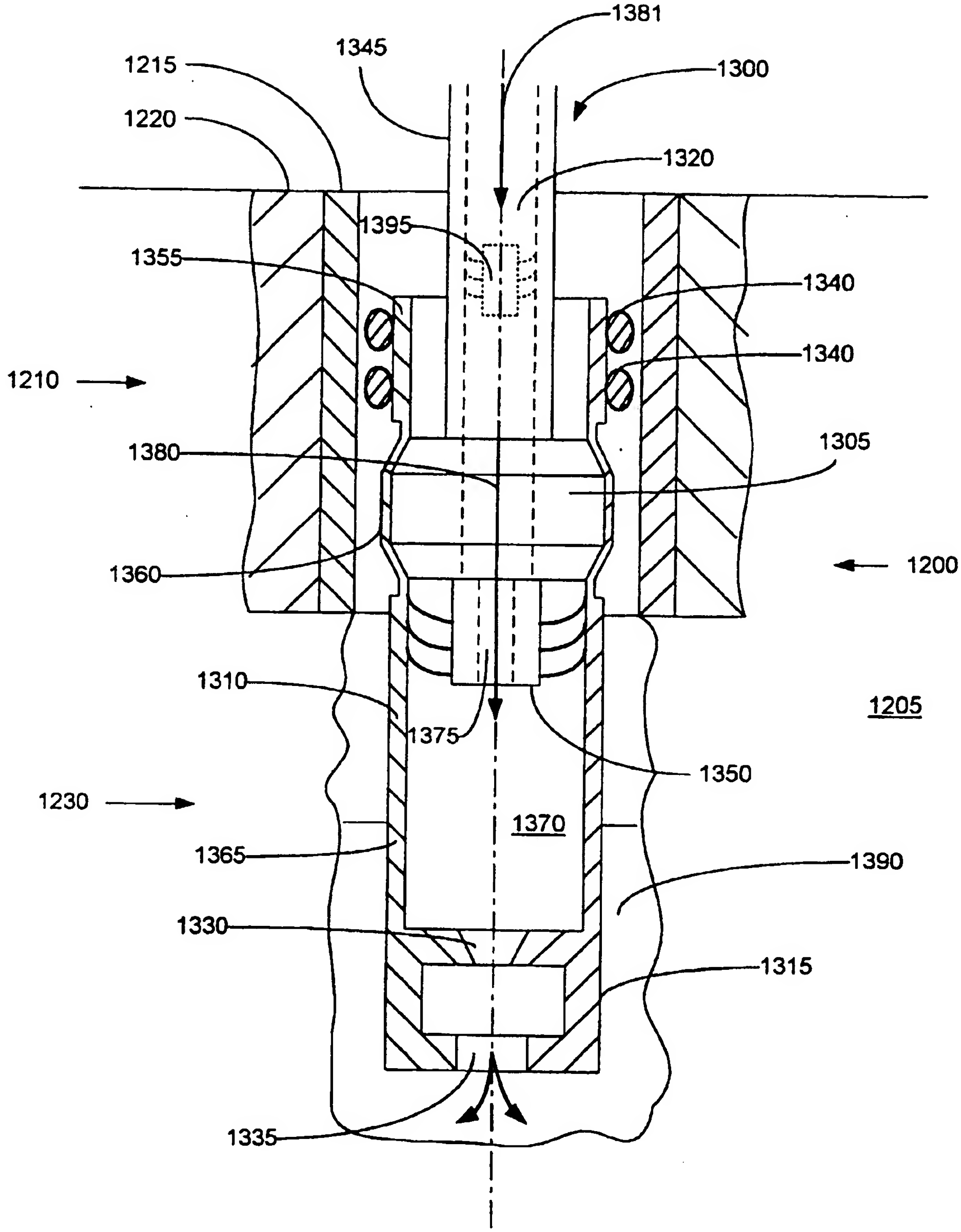
1370
1365
1390
1330
1315
1335

FIGURE 11c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1210
1380
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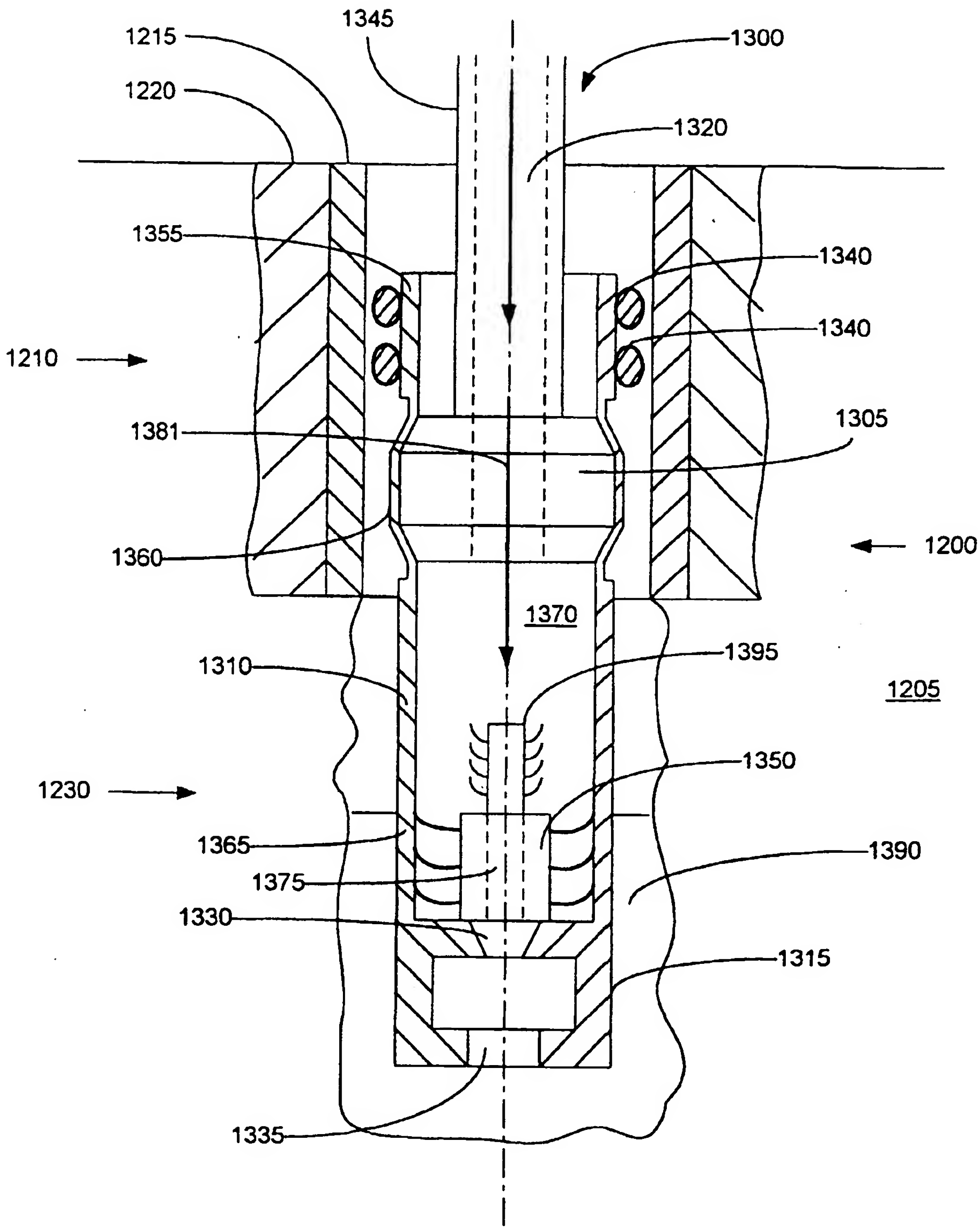
1310
1205
1375
1350
1230
1370
1365
1390
1330
1315
1335

FIGURE 11d


1345
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1320
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1340
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1210
1381
1305
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1205
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1350
1365
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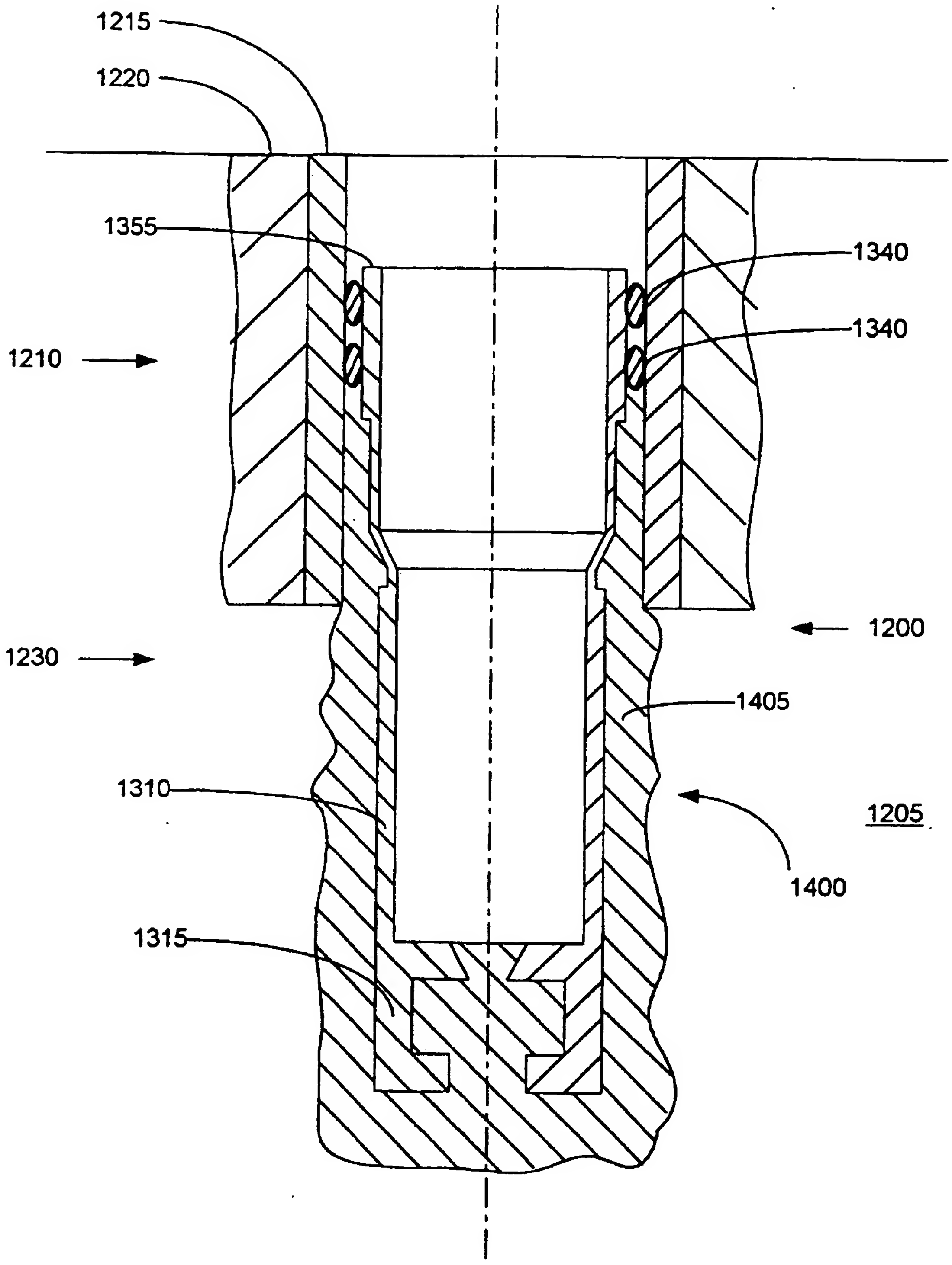
1375
1330
1315
1335

FIGURE 11e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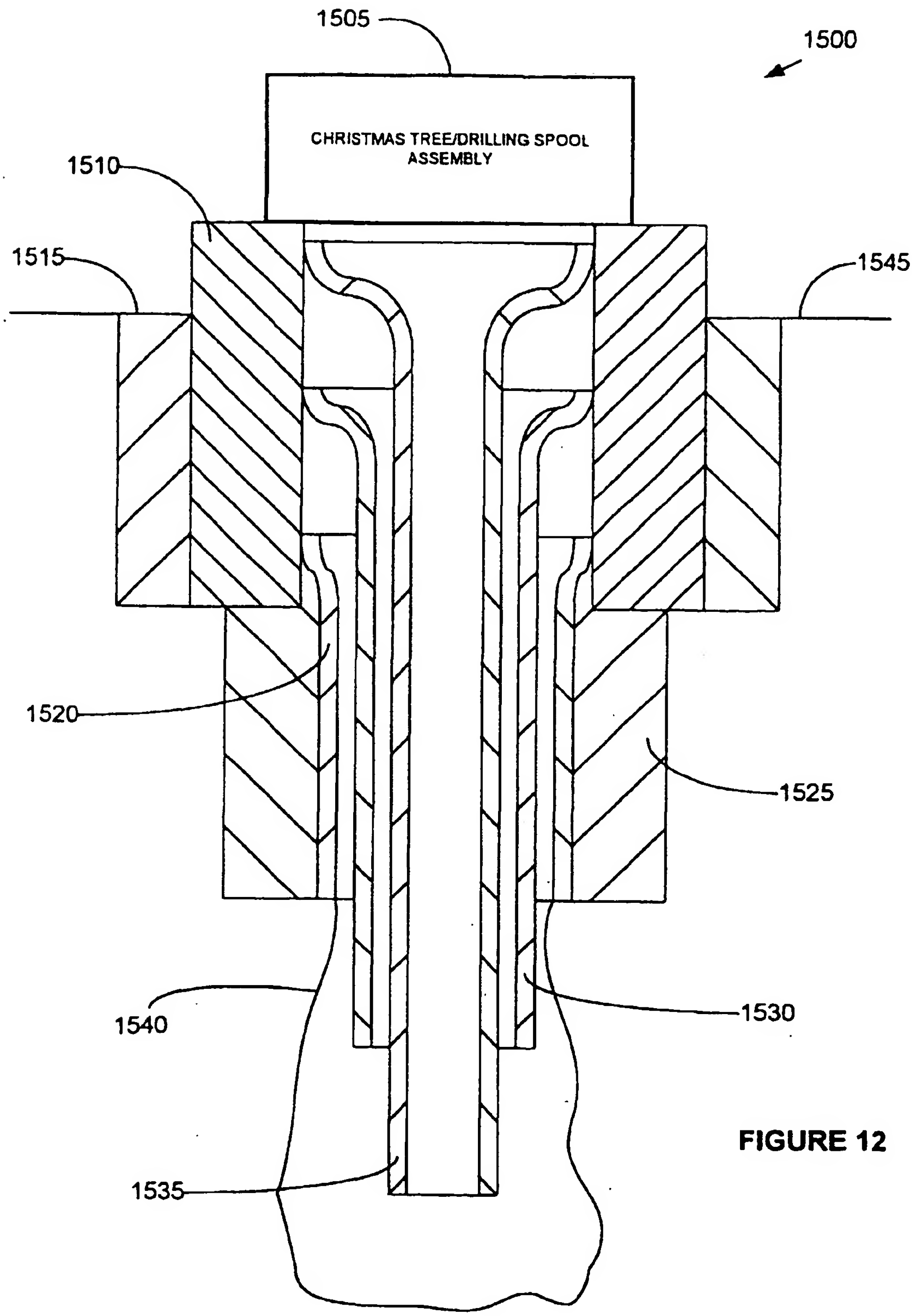
1205
1400
1315

FIGURE 11f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CHRISTMAS TREE/DRILLING SPOOL ASSEMBLY
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1535

FIGURE 12

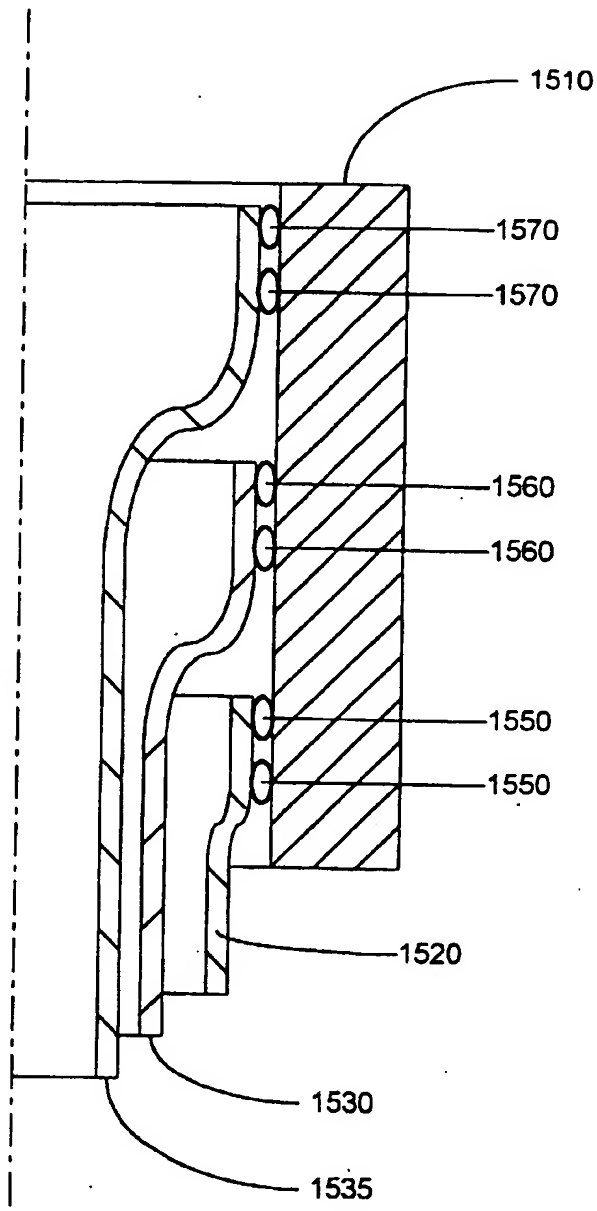


FIGURE 13

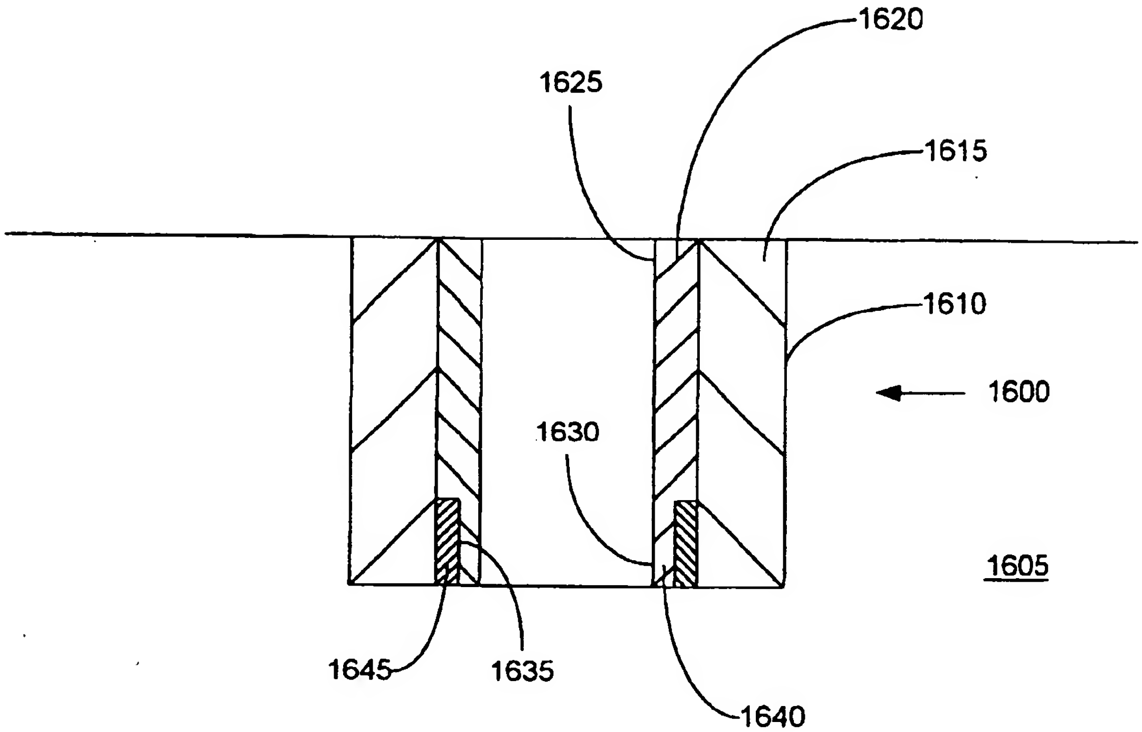


FIGURE 14a

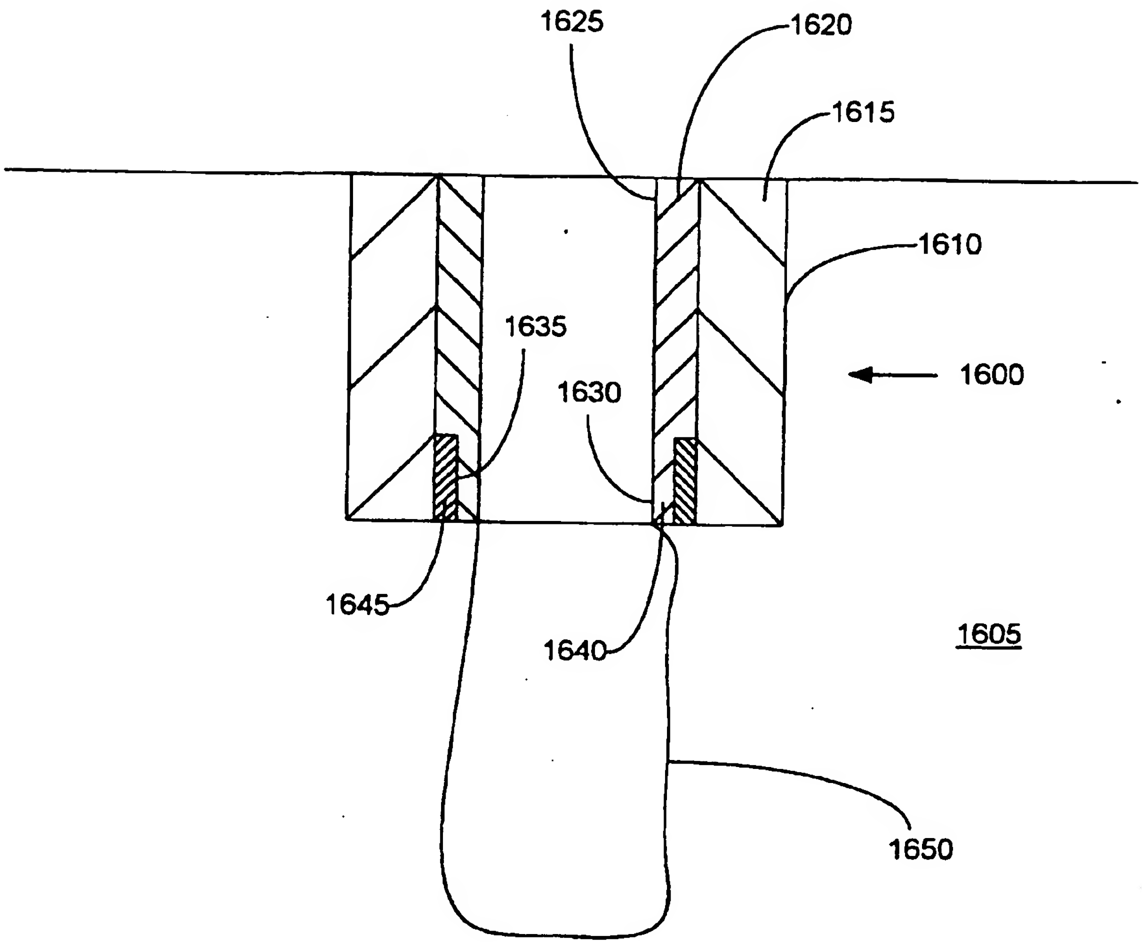
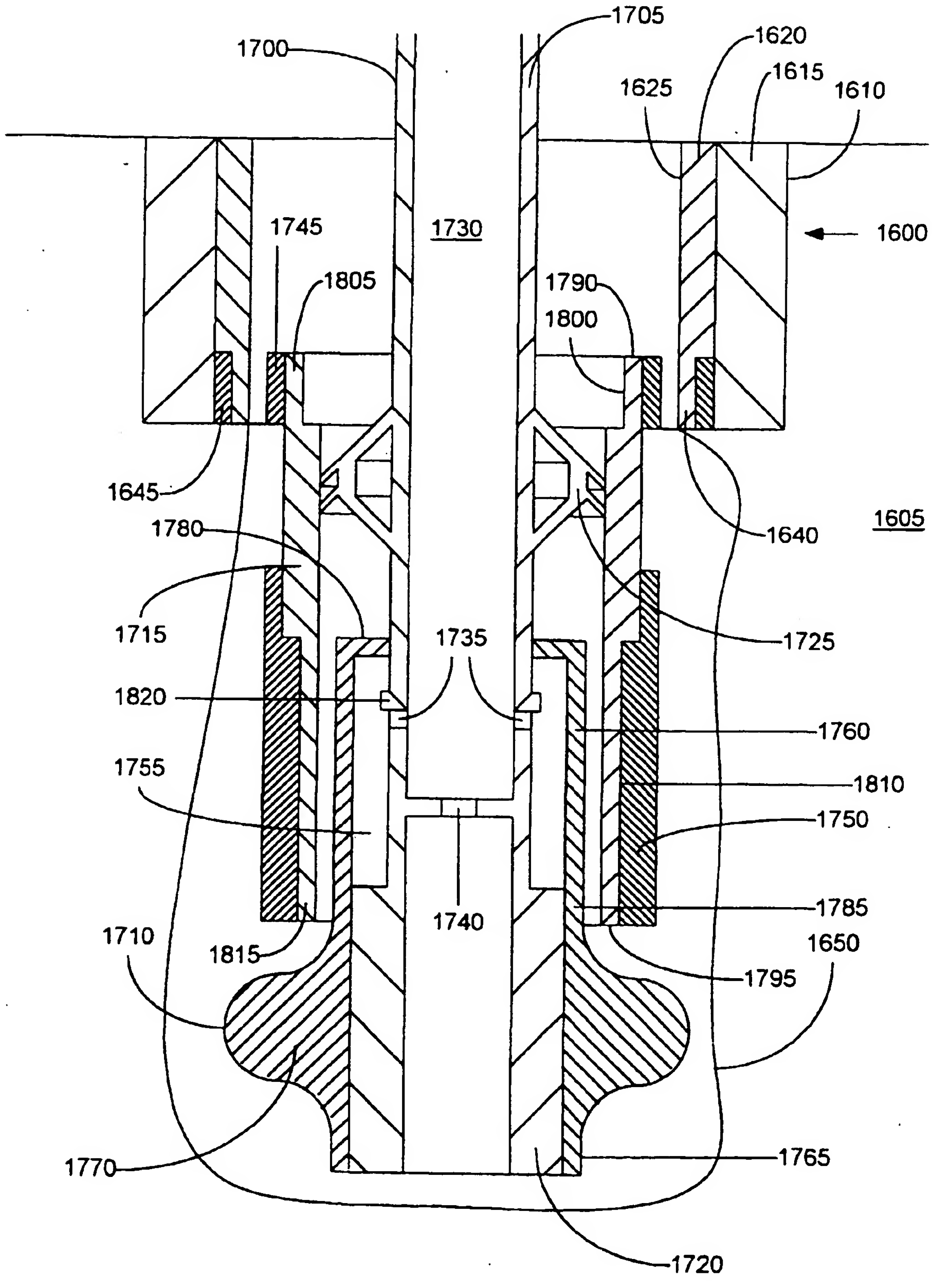


FIGURE 14b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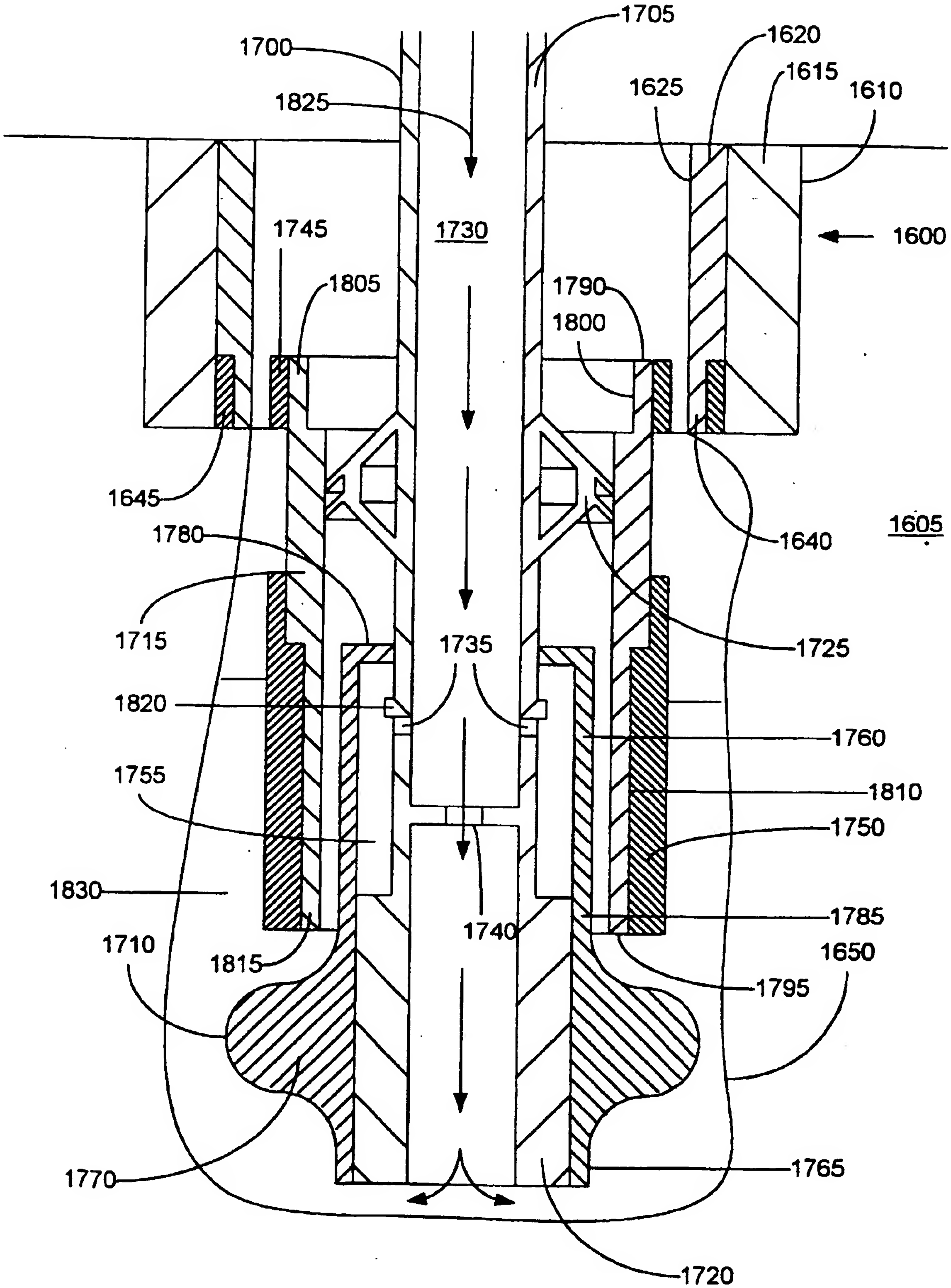
1765
1720

FIGURE 14c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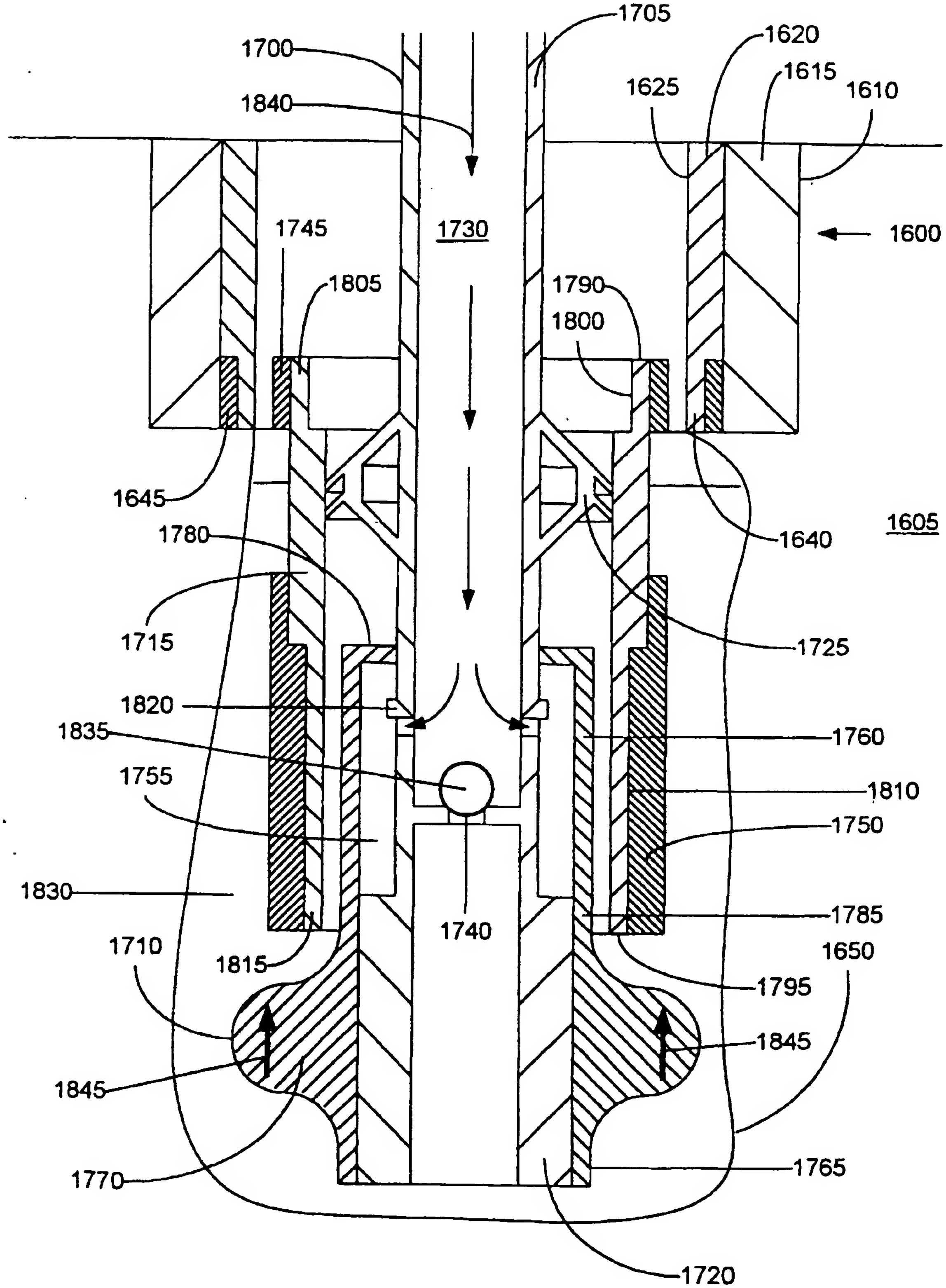
1765
1720

FIGURE 14d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1765
1720

FIGURE 14e

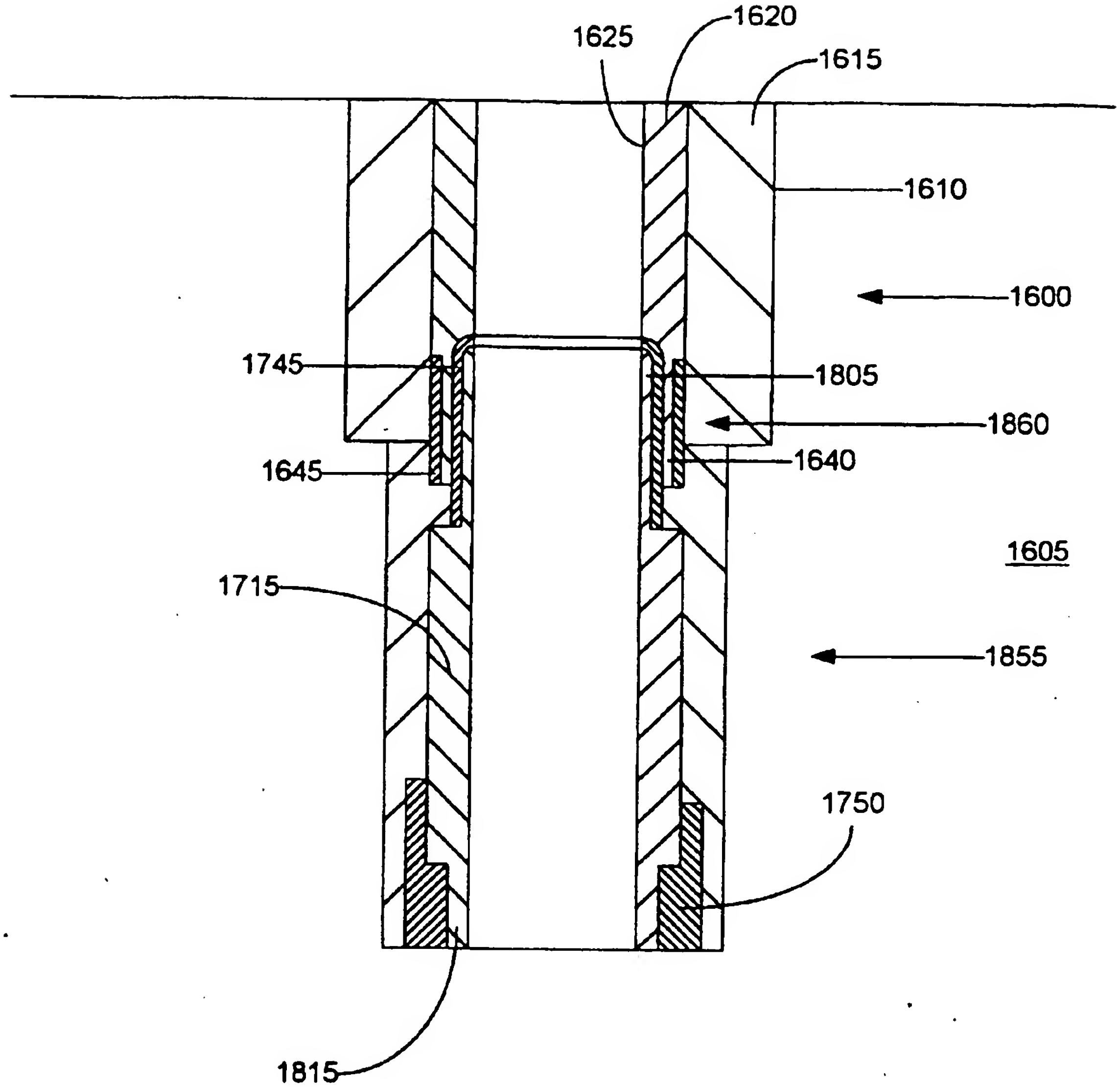
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FIGURE 14f

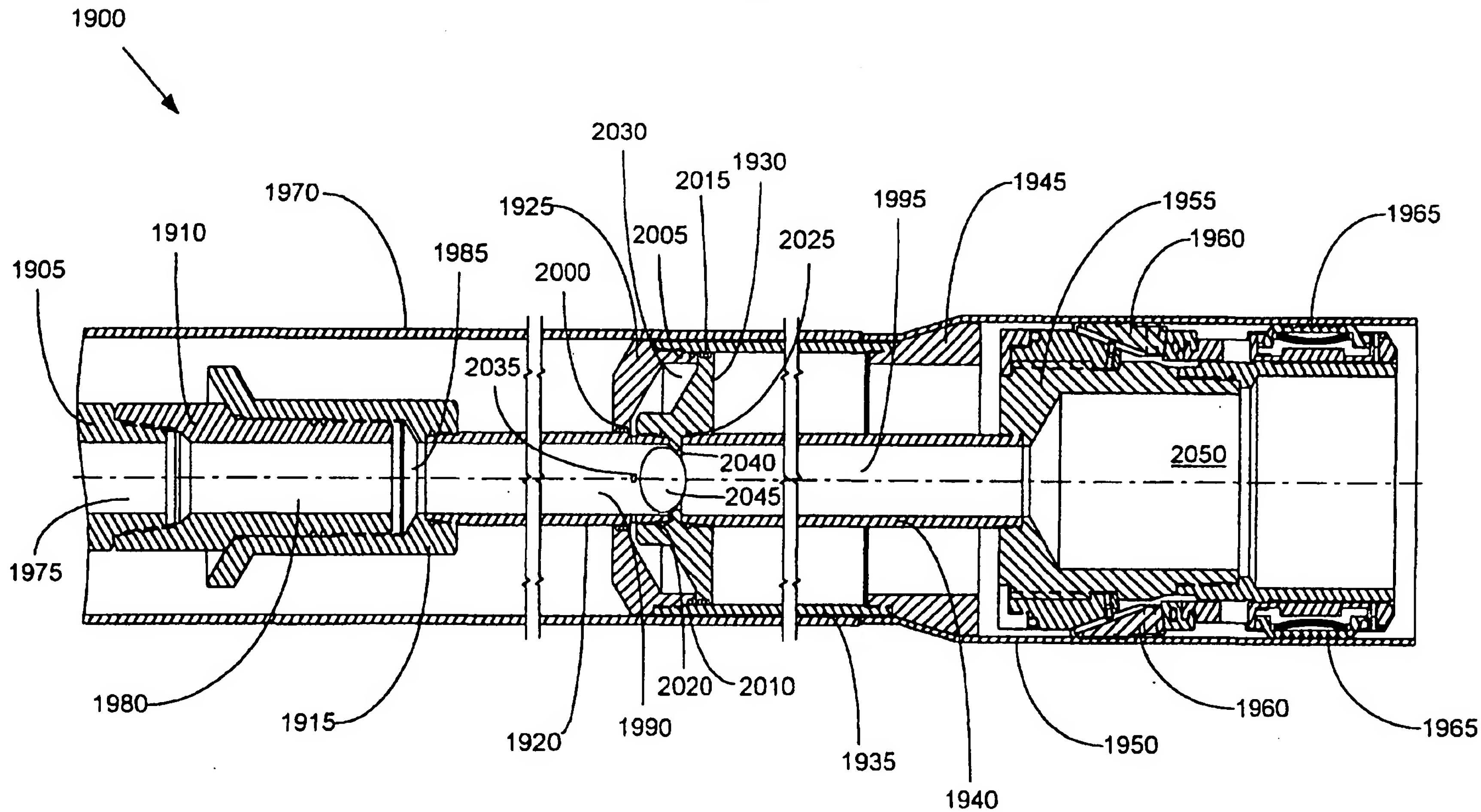
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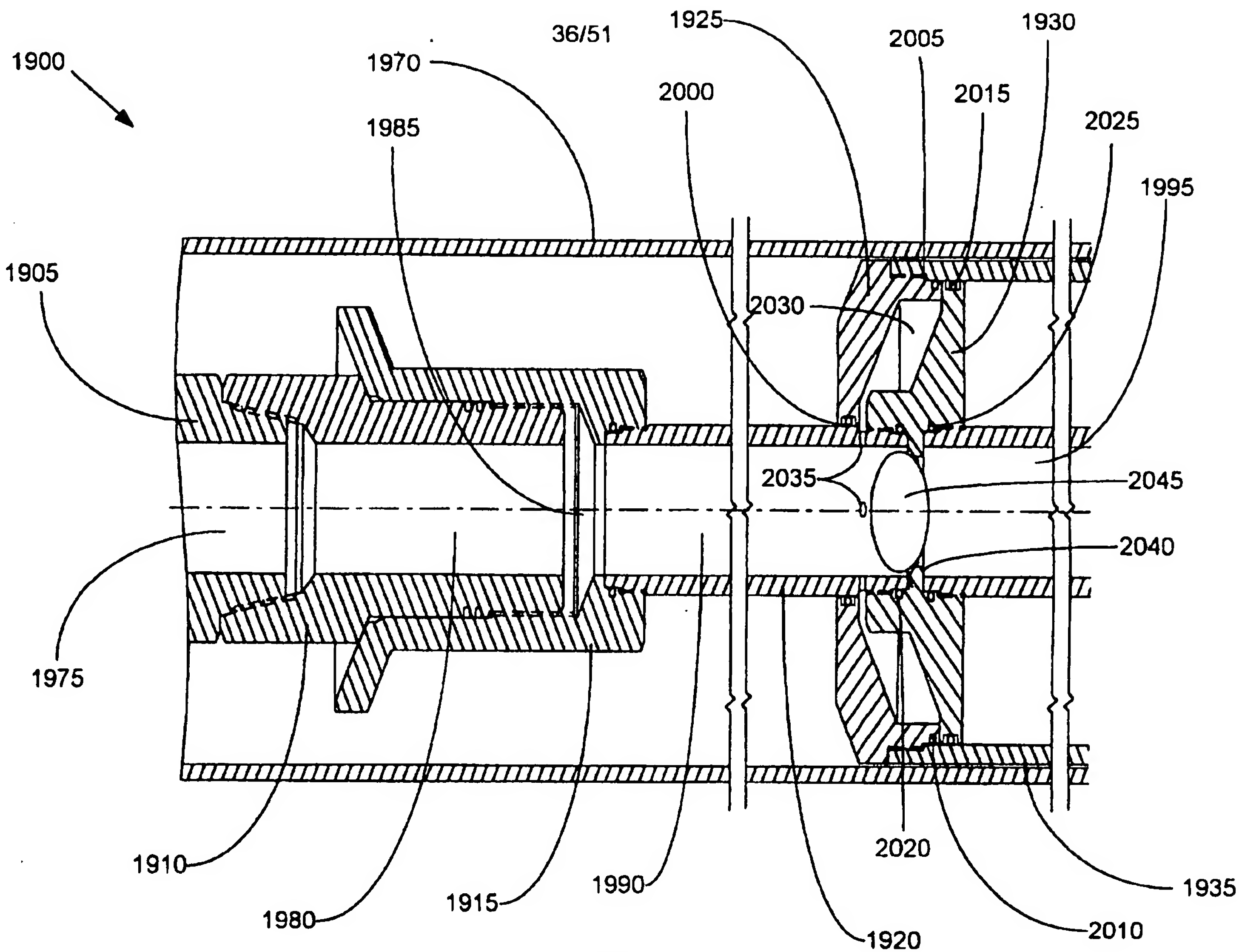
FIGURE 15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2020
2010
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FIGURE 15a

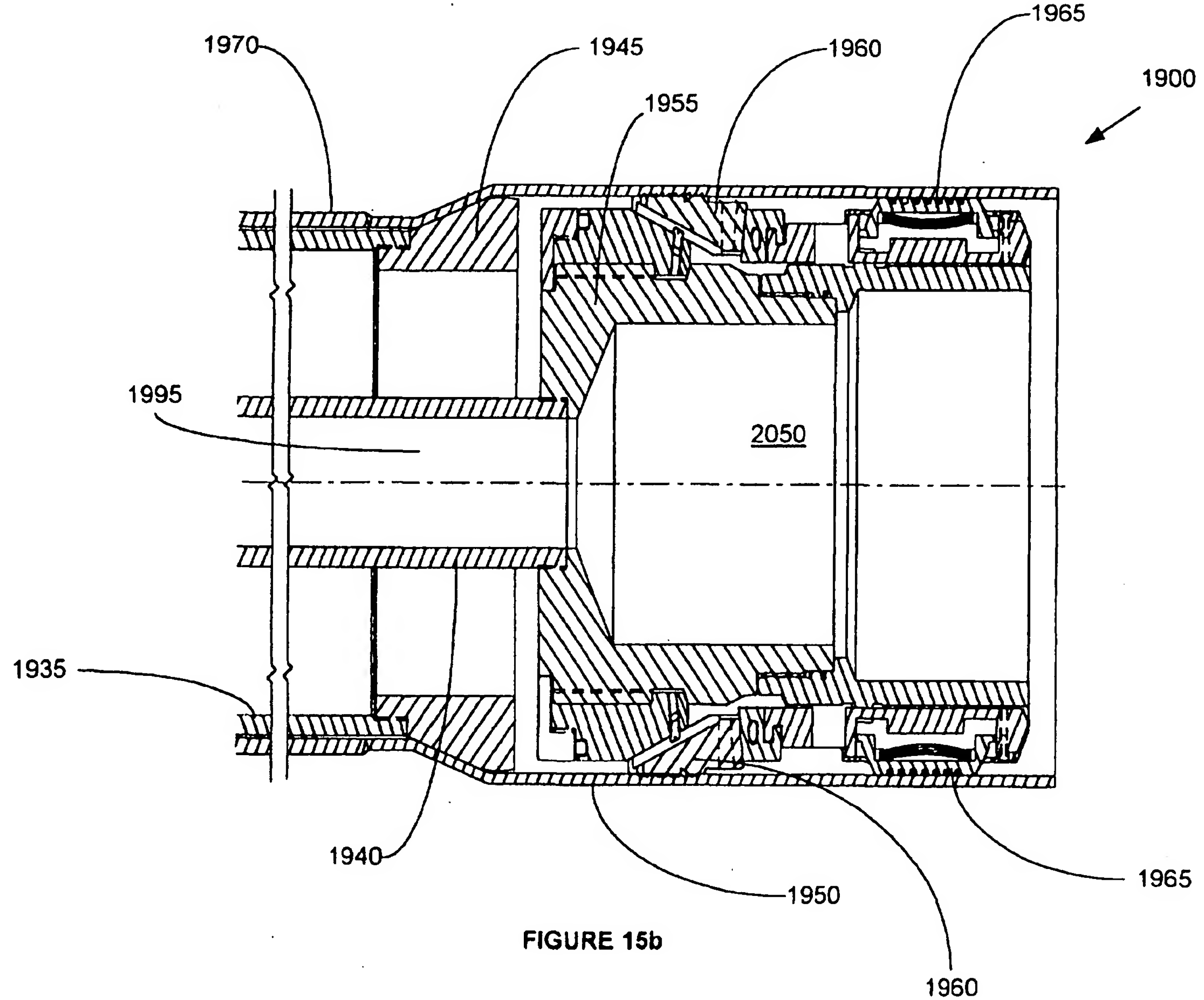
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FIGURE 15b

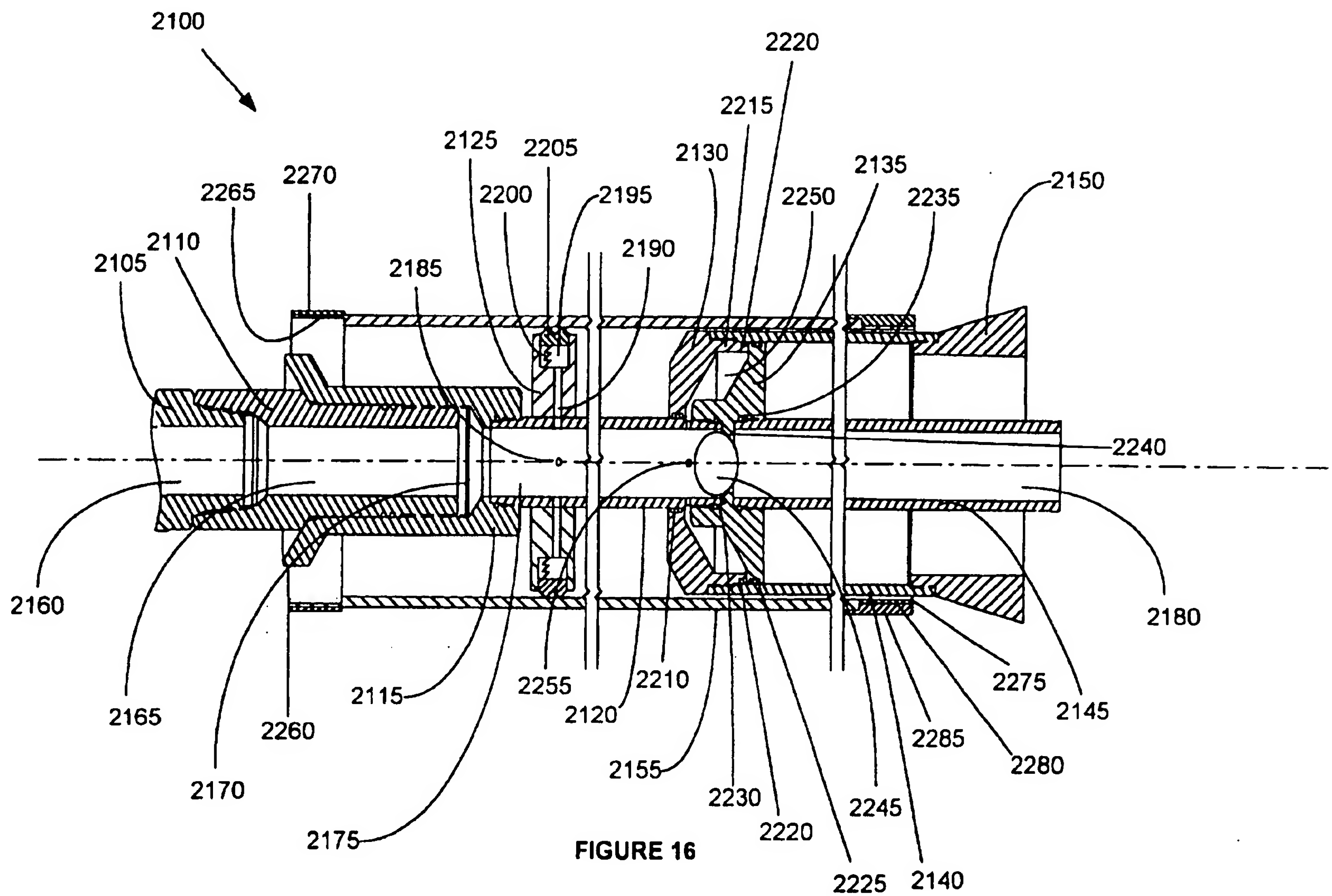
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FIGURE 16

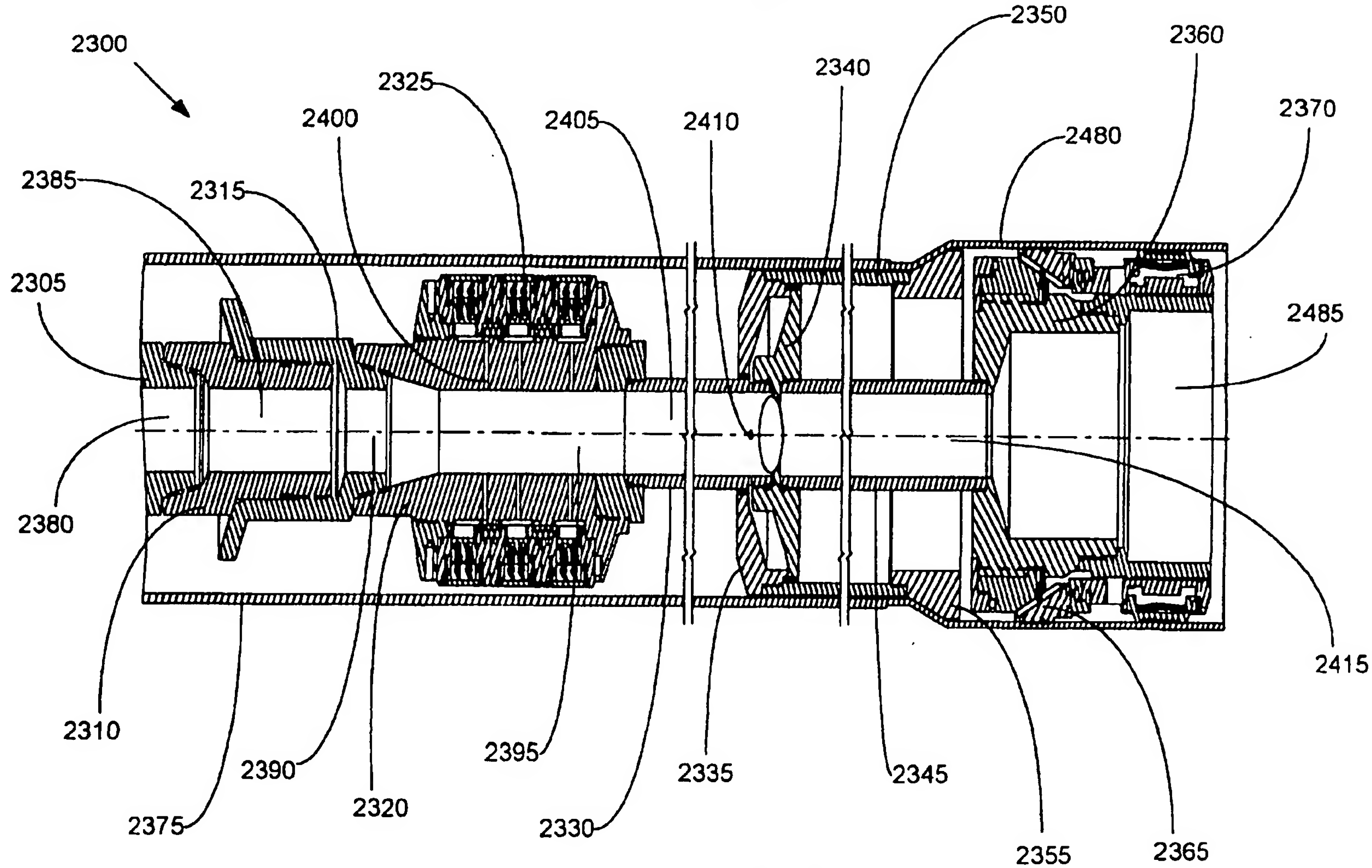
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FIGURE 17

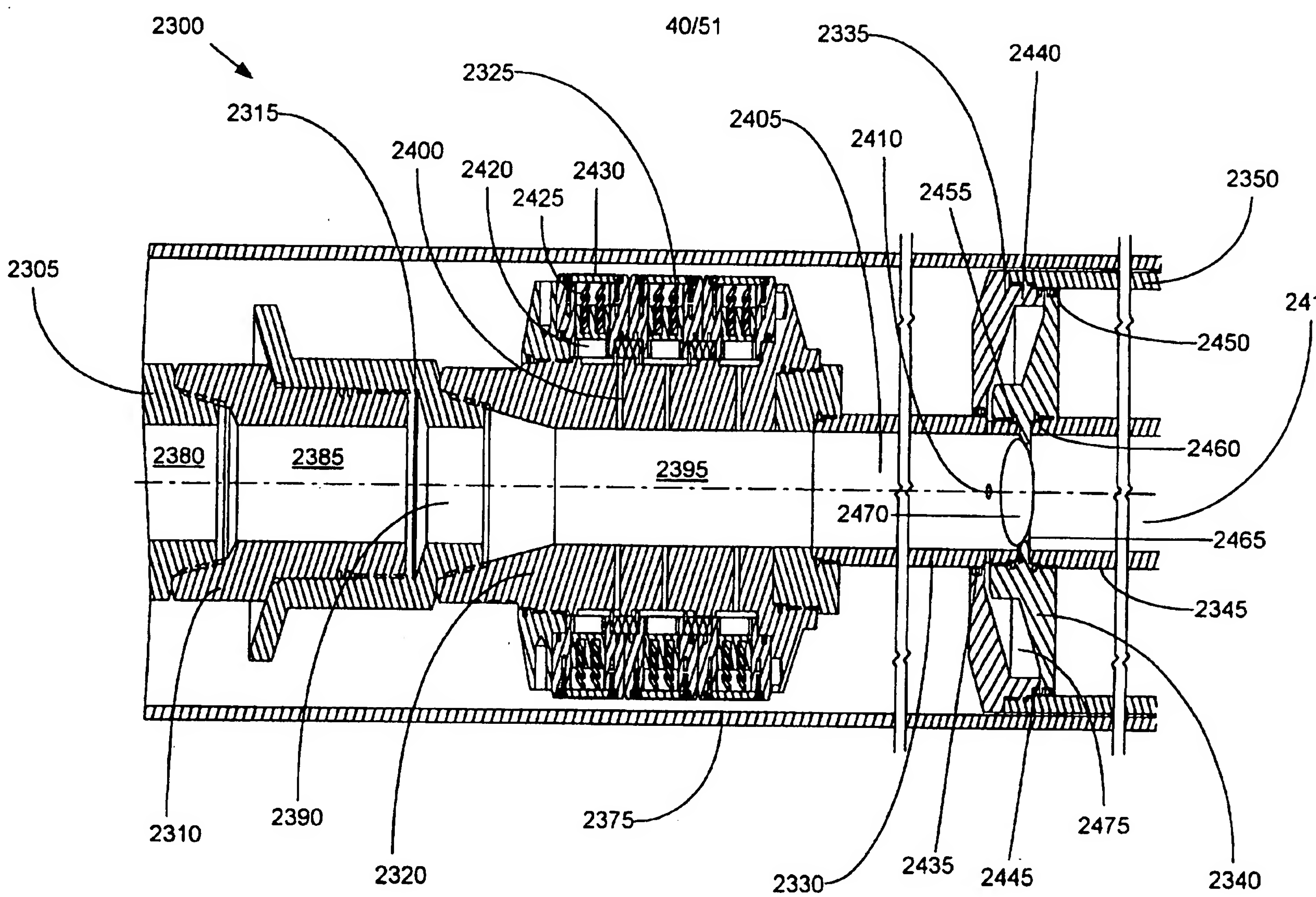
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FIGURE 17a

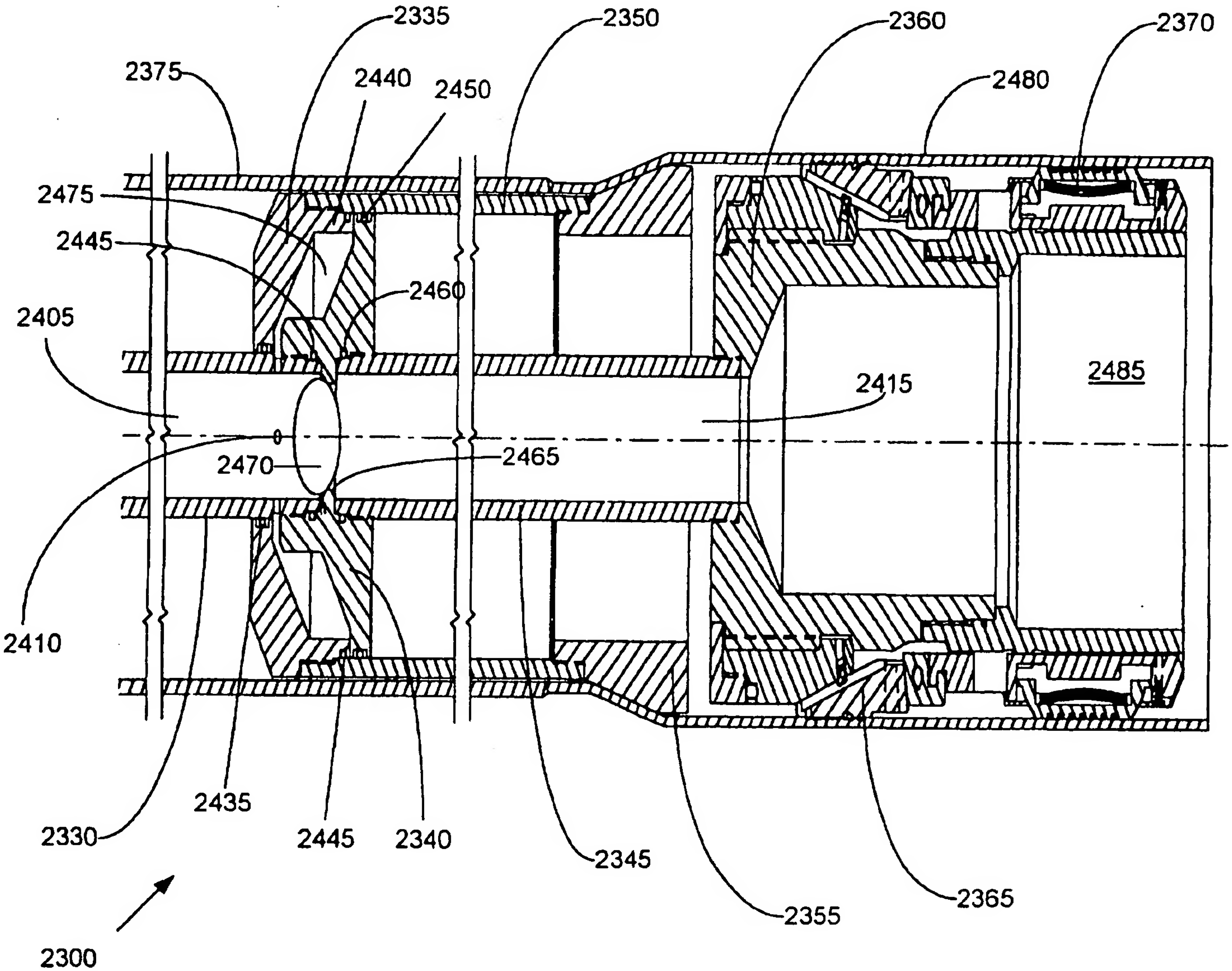
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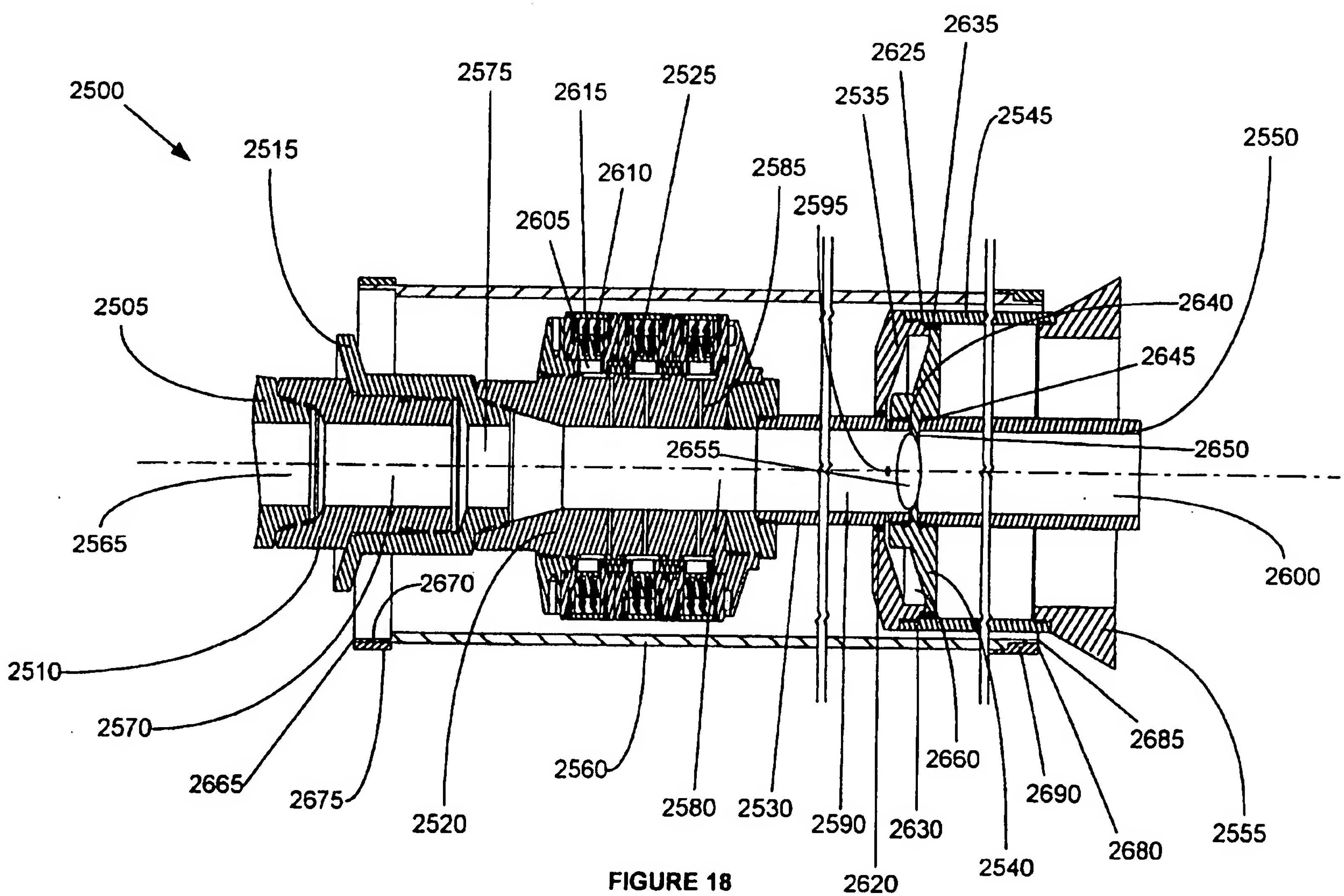
FIGURE 17b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2645
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2680
2685
2555

FIGURE 18

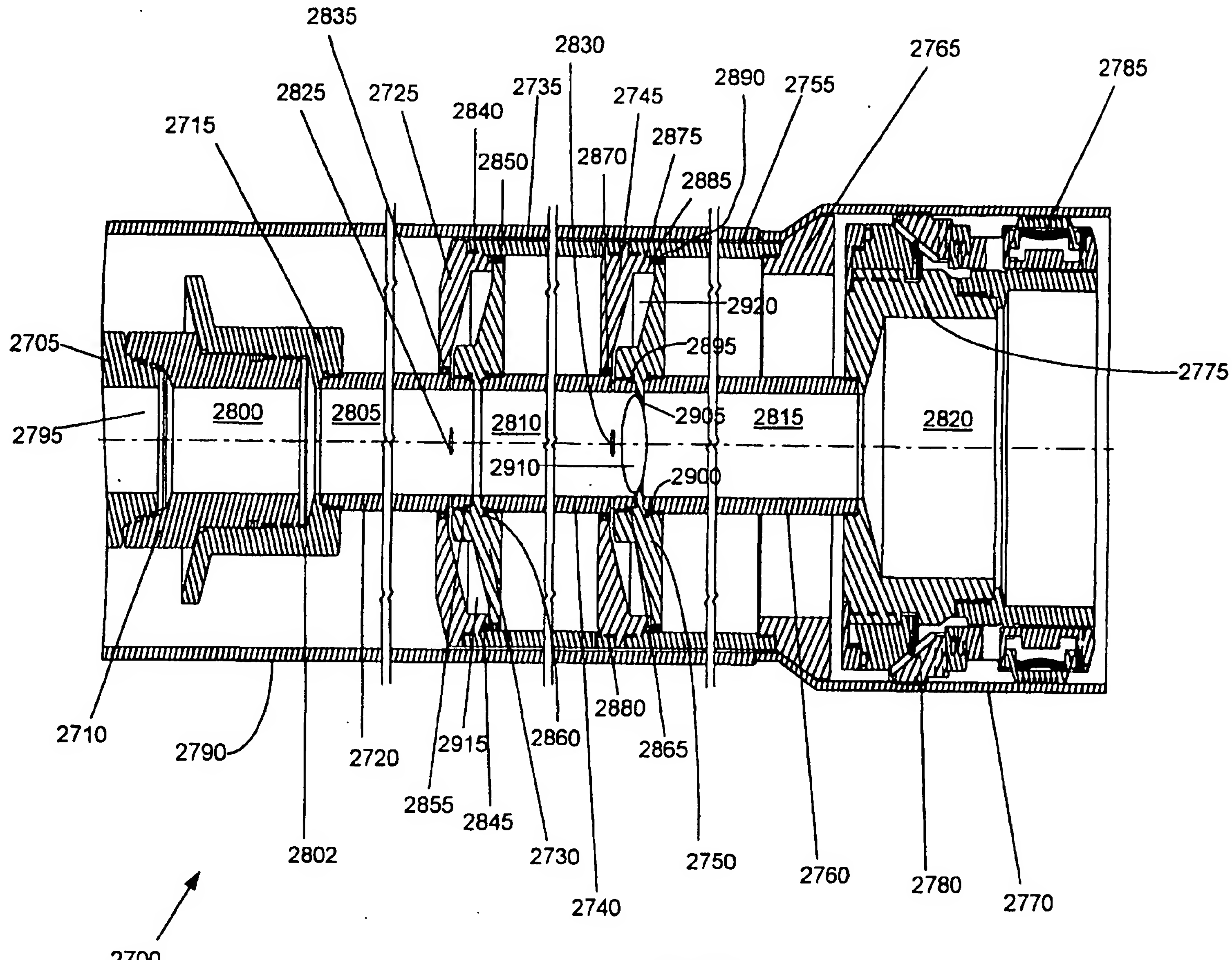
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FIGURE 19

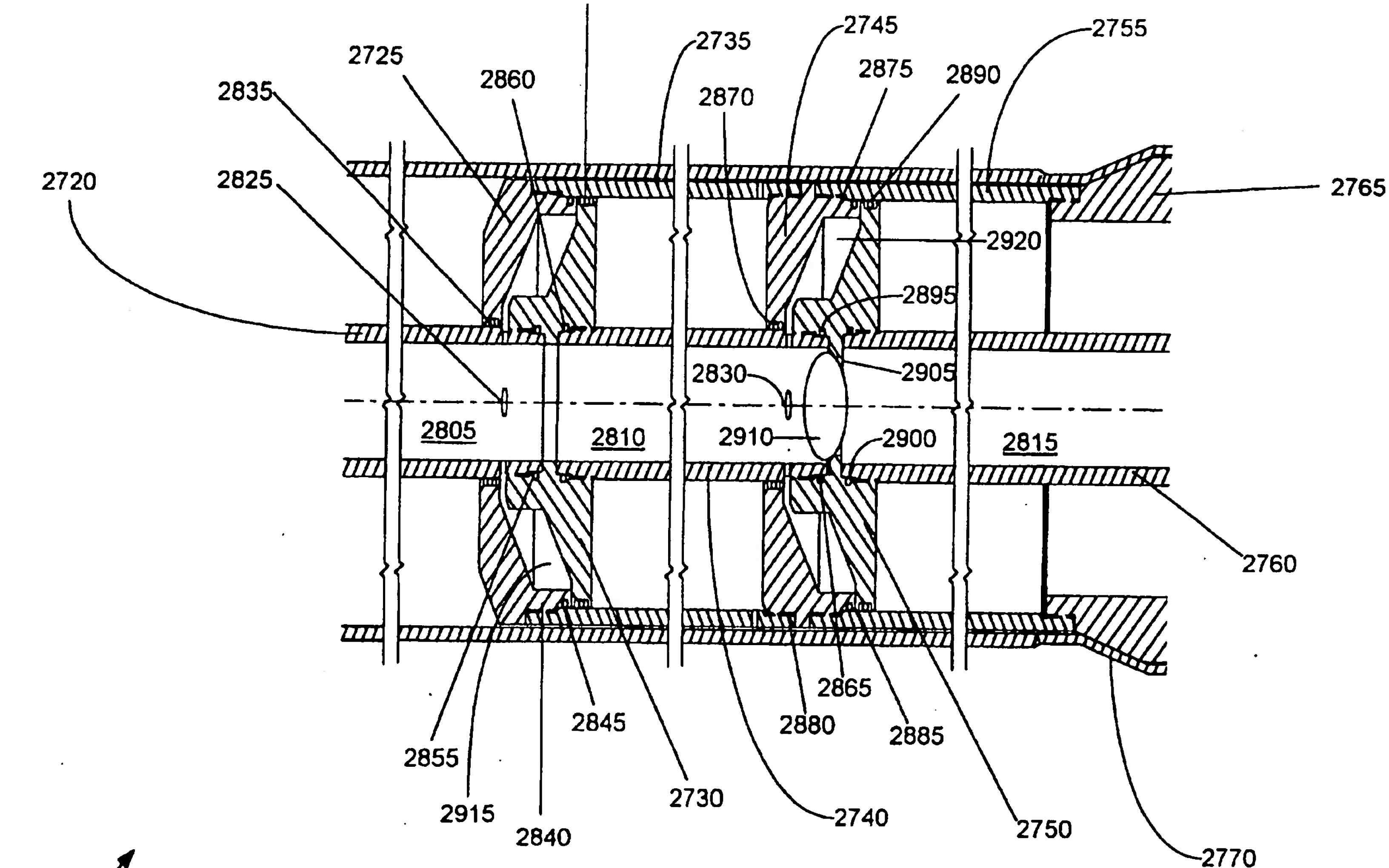
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FIGURE 19a

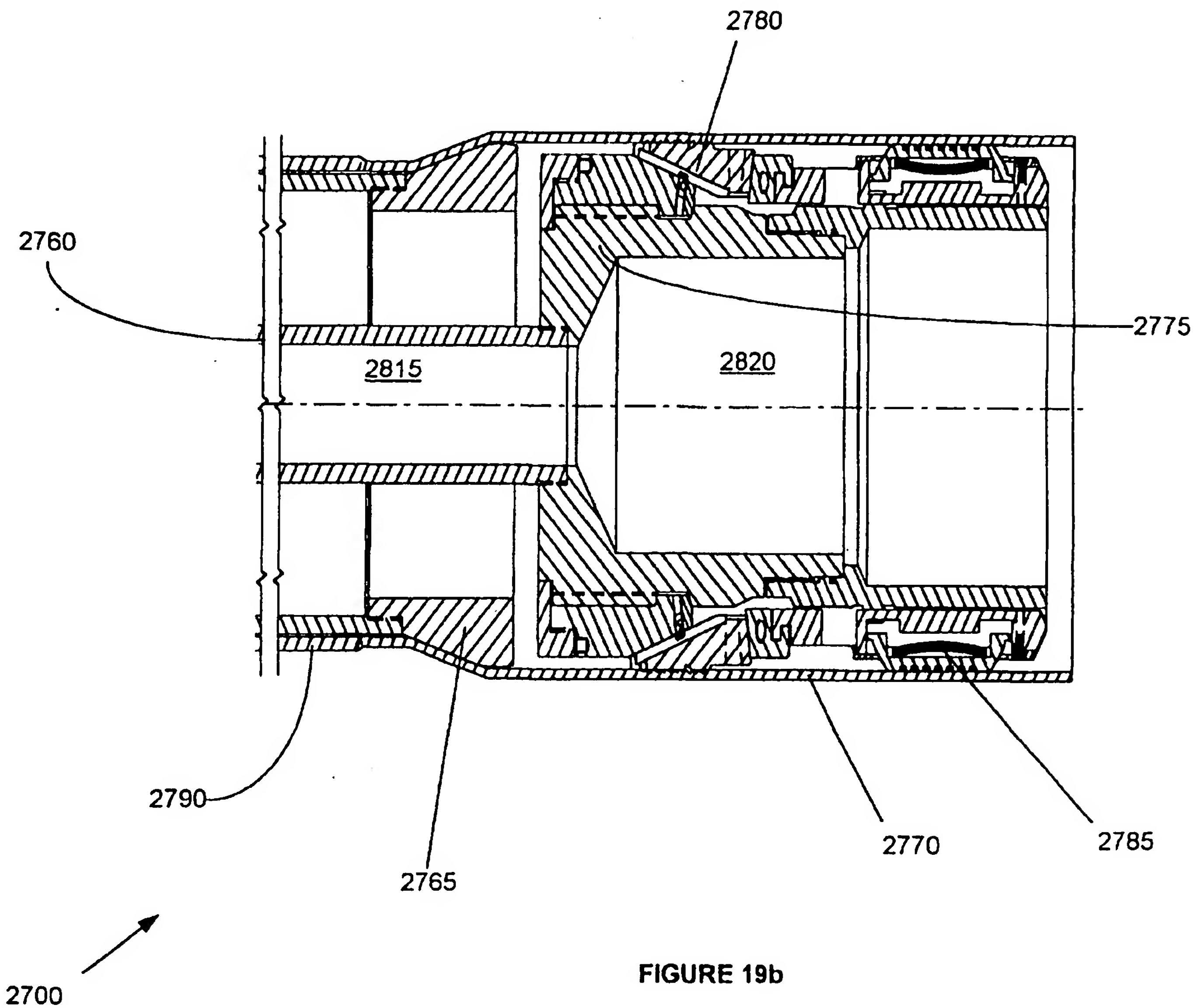

FIGURE 19b

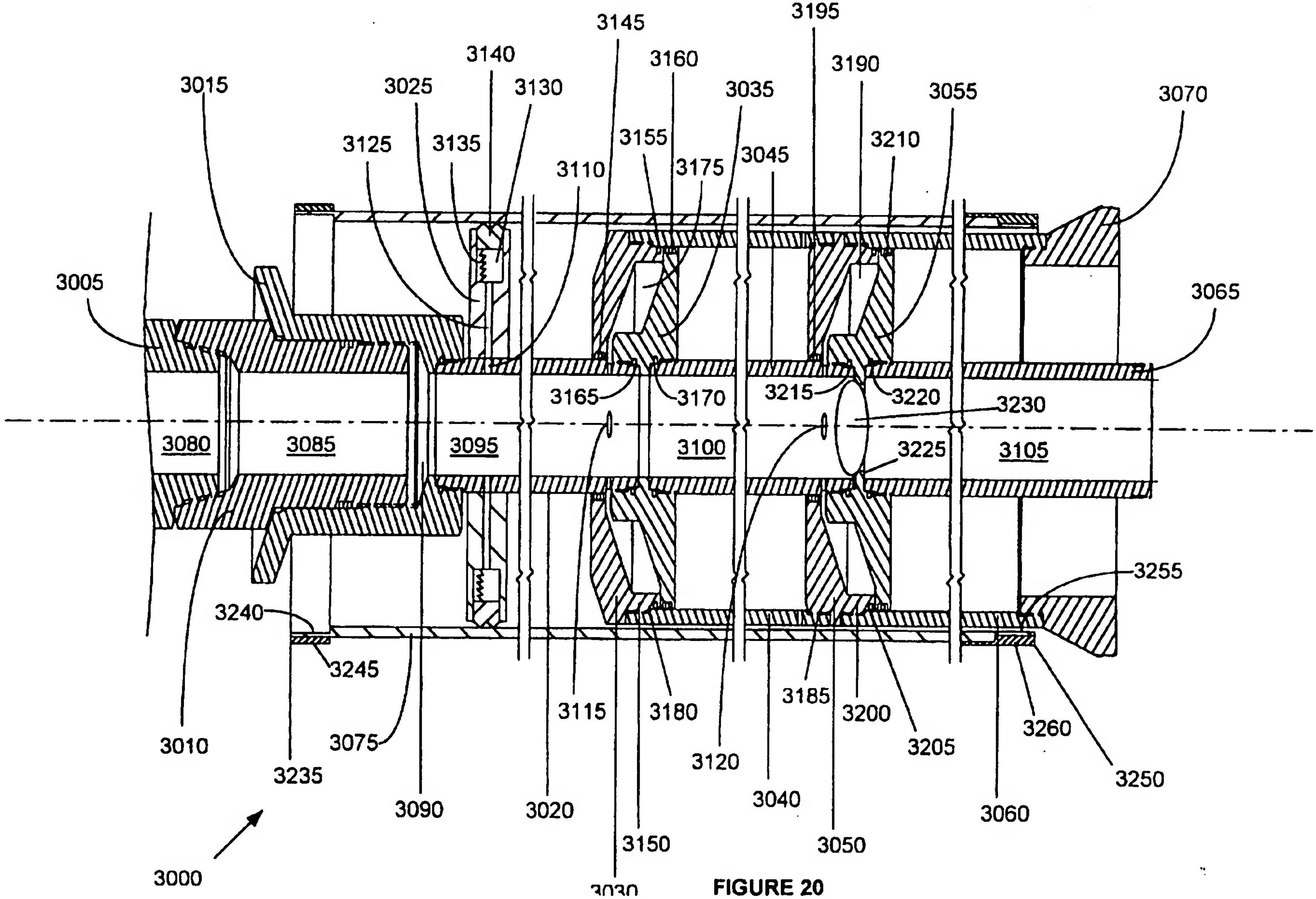
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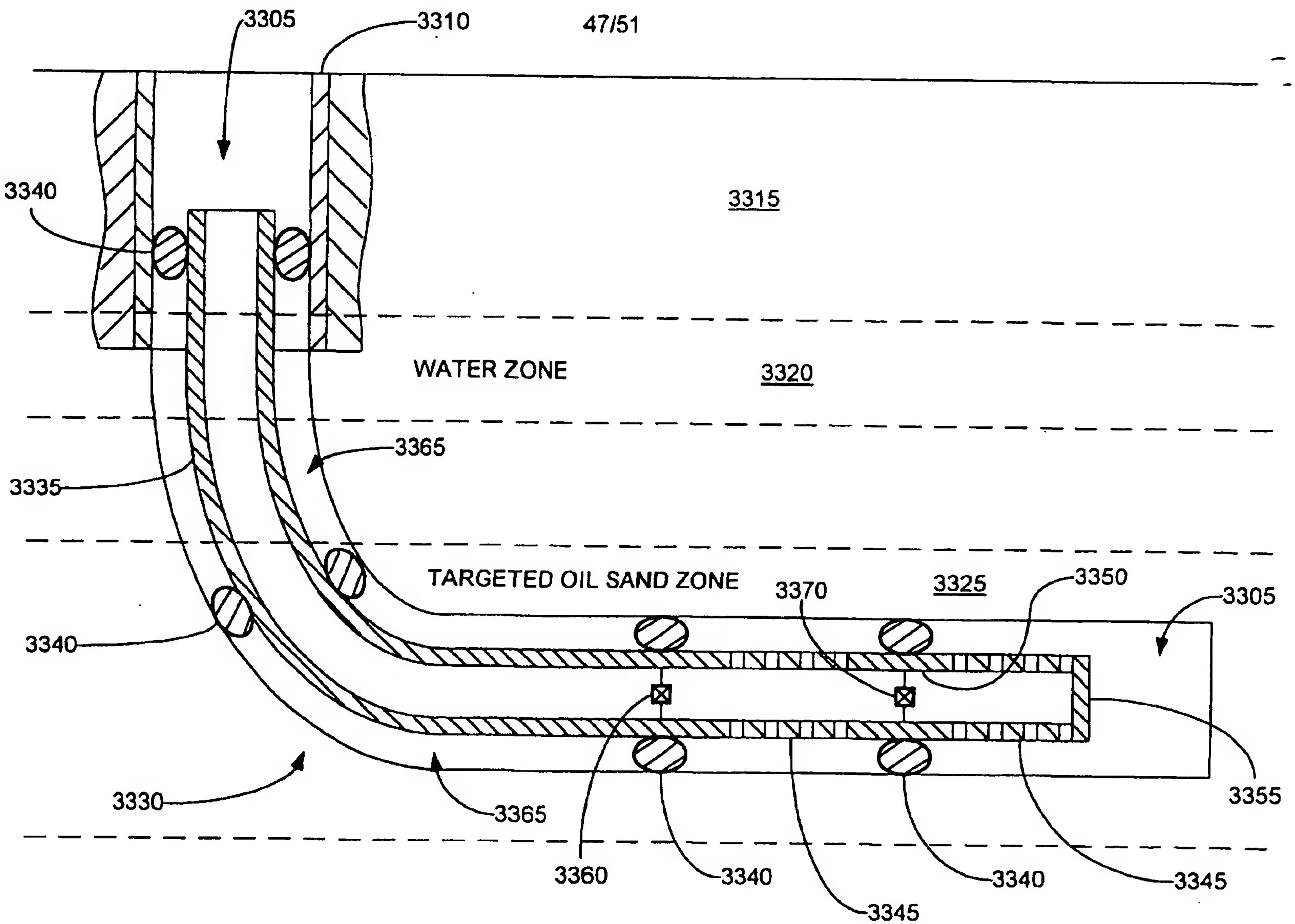
FIGURE 20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3315
WATER ZONE
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3335
TARGETED OIL SAND ZONE
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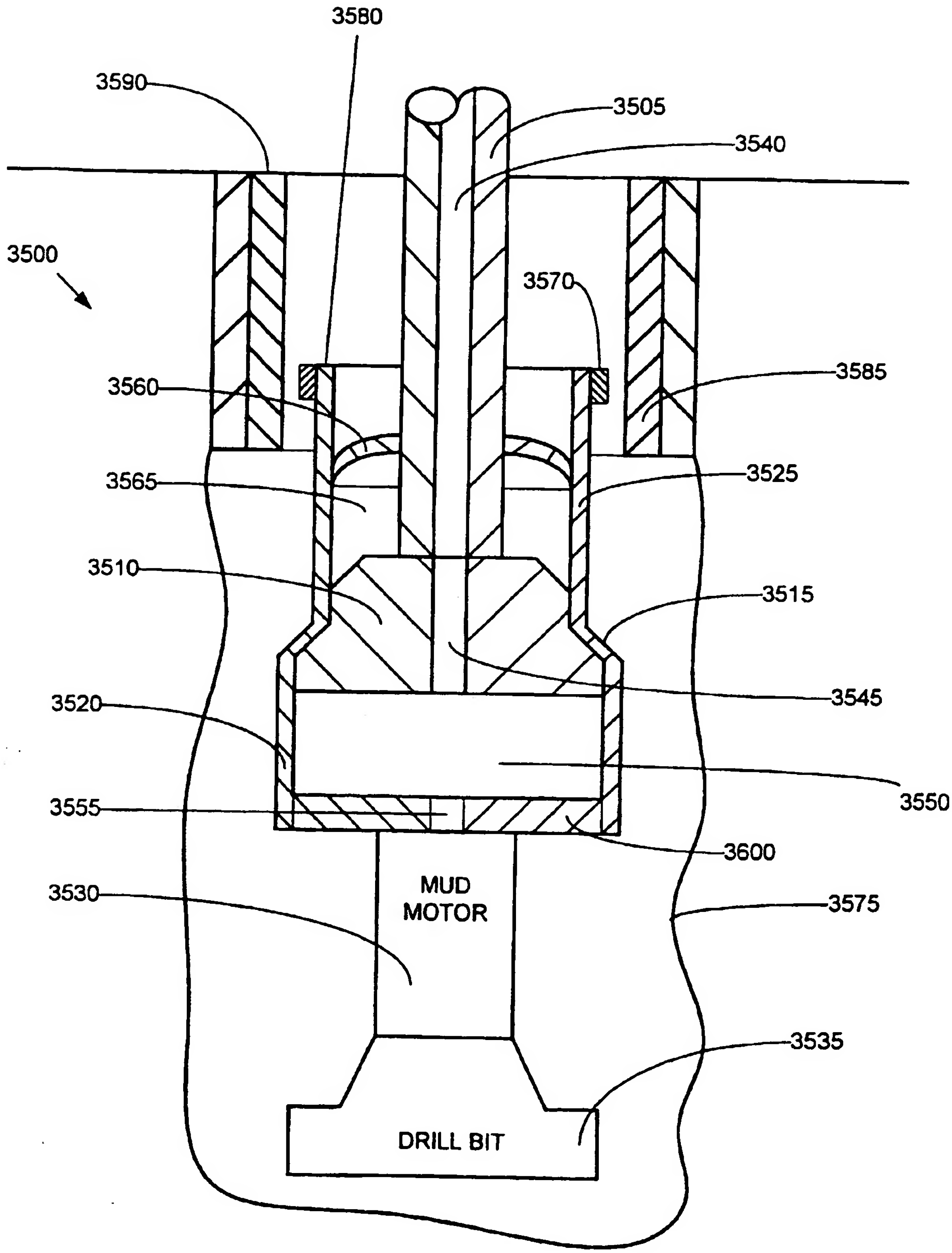
3345

FIGURE 21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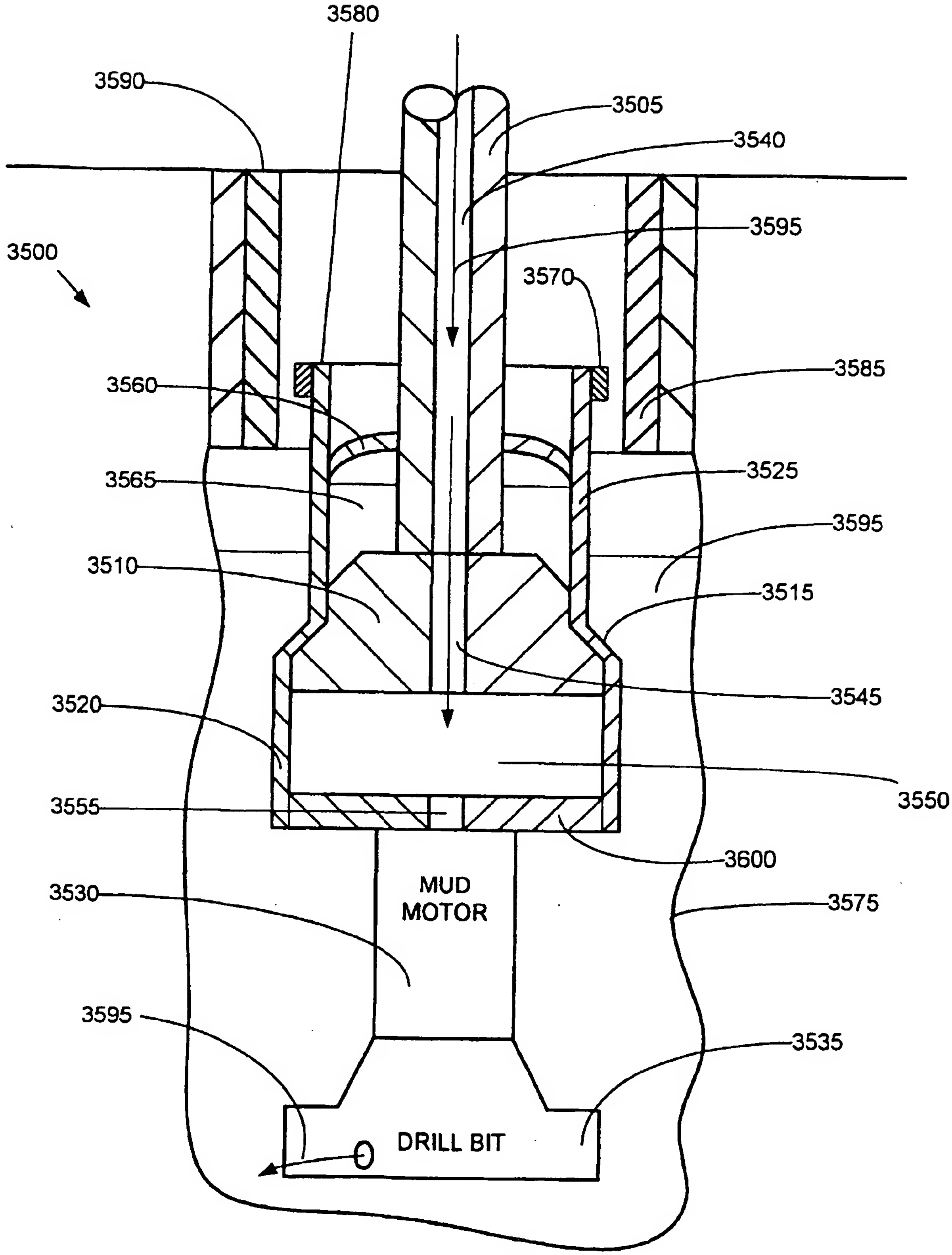
3600
MUD MOTOR
3530
3575
3535
DRILL BIT

FIGURE 22A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MUD MOTOR
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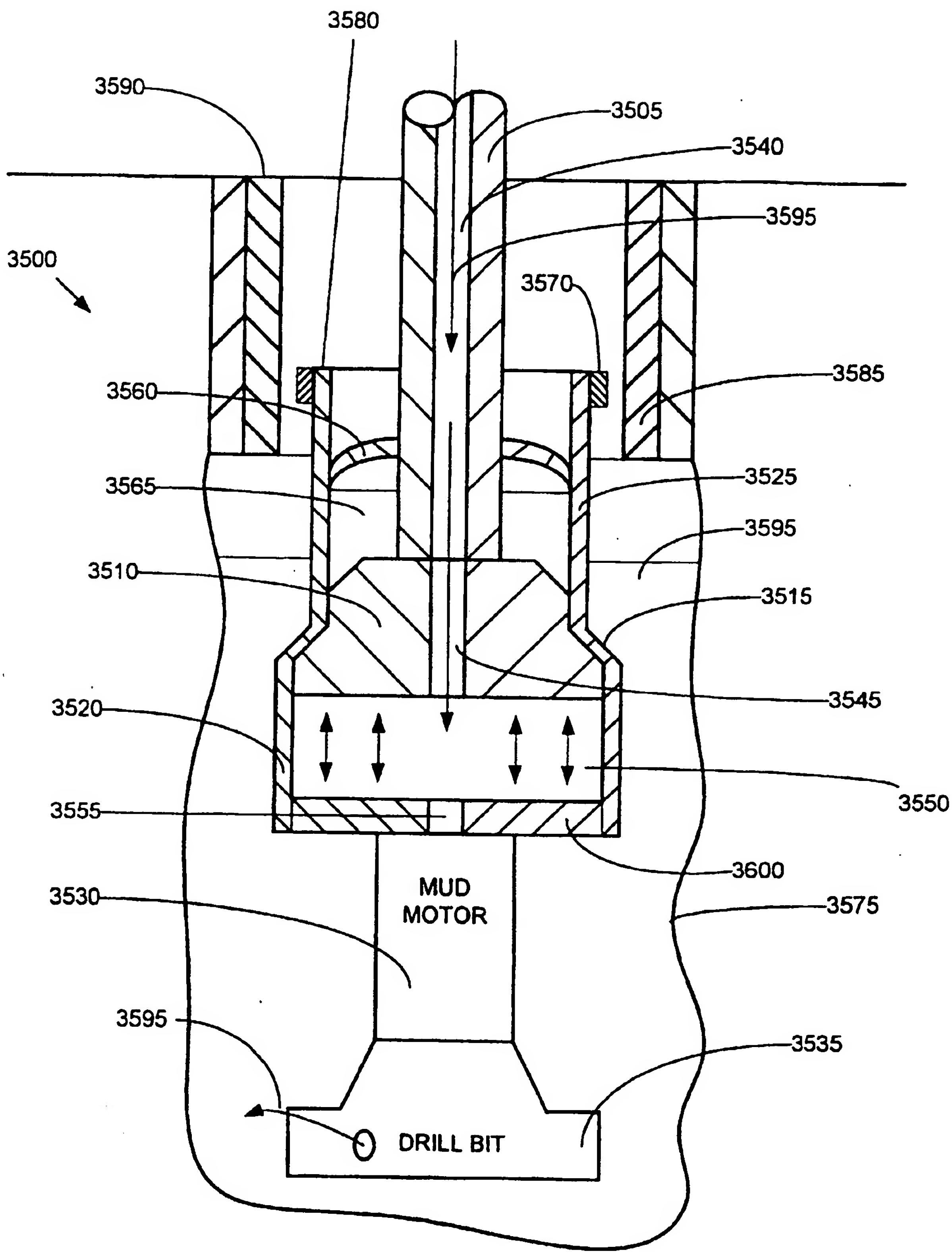
3575
3595
3535
DRILL BIT

FIGURE 22B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3520
3550
3555
3600
MUD
MOTOR
3575
3530
3595
3535
DRILL BIT

FIGURE 22C

wellbore casing is formed simultaneous with the drilling out of a new section of wellbore.

During the operation of the apparatus 3500, the apparatus 3500 is lowered into the wellbore 3575 until the drill bit 3535 is proximate the bottom of the wellbore 3575. Throughout this process, the tubular member 3525 is preferably supported by the mandrel 3510. The apparatus 3500 is then lowered until the drill bit 3535 is placed in contact with the bottom of the wellbore 3575. At this point, at least a portion of the weight of the tubular member 3525 is supported by the drill bit 3535.

The fluidic material 3595 is then pumped into the first fluid passage 3540, second fluid passage 3545, pressure chamber 3550, third fluid passage 3555, and the inlet of the mud motor 3530. The mud motor 3530 then drives the drill bit 3535 to drill out a new section of the wellbore 3575. Once the differential pressure across the mud motor 3530 exceeds the minimum extrusion pressure for the tubular member 3525, the tubular member 3525 begins to extrude off of the mandrel 3510. As the tubular member 3525 is extruded off of the mandrel 3510, the weight of the extruded portion of the tubular member 3525 is transferred to and supported by the drill bit 3535. The pumping pressure of the fluidic material 3595 is maintained substantially constant throughout this process. At some point during the process of extruding the tubular member 3525 off of the mandrel 3510, a sufficient portion of the weight of the tubular member 3525 is transferred to the drill bit 3535 to stop the extrusion process due to the opposing force. Continued drilling by the drill bit 3535 eventually transfers a sufficient portion of the weight of the extruded portion of the tubular member 3525 back to the mandrel 3510. At this point, the extrusion of the tubular member 3525 off of the mandrel 3510 continues. In this manner, the support member 3505 never has to be moved and no drillpipe connections have to be made at the surface since the new section of the wellbore casing within the newly drilled section of wellbore is created by the constant downward feeding of the expanded tubular member 3525 off of the mandrel 3510.

Once the new section of wellbore that is lined with the fully expanded tubular member 3525 is completed, the support member 3505 and mandrel 3510 are removed from the wellbore 3575. The drilling assembly including the mud motor 3530 and drill

bit 3535 are then preferably removed by lowering a drillstring into the new section of wellbore casing and retrieving the drilling assembly by using the latch 3600. The expanded tubular member 3525 is then cemented using conventional squeeze cementing methods to provide a solid annular sealing member around the periphery of the expanded tubular member 3525.

Alternatively, the apparatus 3500 may be used to repair or form an underground pipeline or form a support member for a structure. The teachings of the apparatus 3500 are combined with the teachings of the arrangements illustrated in Figures 1-21. For example, by operably coupling the mud motor 3530 and drill bit 3535 to the pressure chambers used to cause the radial expansion of the tubular members of the arrangements illustrated and described with reference to Figures 1-21, the use of plugs may be eliminated and radial expansion of tubular members can be combined with the drilling out of new sections of wellbore.

Registered Trade Marks

Lubriplate to Lubriplate (RTM)
Teflon to Teflon (RTM)

Non-Metric Units

0.75 to 47 inches and 1.05 to 48 inches (1.905 to 119.38 centimetres and 2.667 to 121.92 centimetres)
40 to 20,000 feet (12.192 to 6096.00 meters)
0 to 3,000 gallons/minute and 0 to 9,000 psi (0 to 11356.24 litres/minute and 0 to 620.528 bar)
1,000 to 1,000 000 lbf (.478803 to 478.803 bar)
0 to 5,000 psi and 0 to 1,500 gallons/minute (0 to 344.738 bar and 0 to 5618.12 litres/minute)
400 to 10,000 psi and 30 to 4,000 gallons/min (27.58 to 689.476 bar and 113.56 to 15141.68 litres/minute)
500 to 9,000 psi and 40 to 3,000 gallons/min (34.47 to 620.53 bar and 151.42 to 11356.24 litres/minute)
500 to 9,000 psi (34.47 to 620.53 bar)
0 to 5 ft/sec (1.524 meters)
0 to 2 ft/sec (.6096 meters)
50 to 20,000 psi (3.447 to 137.95 bar)
400 to 10,000 psi (27.58 to 689.476 bar)
5 feet (1.524 meters)
1.05 to 48 inches and 1/8 to 2 inches (2.667 to 121.92 and .3175 to 5.08 centimetres)
3.5 to 16 inches and 3/8 to 1.5 inches (8.89 to 40.64 centimetres and .9525 to 3.81)
2.5 to 50 inches and 1/16 to 1.5 inches (6.35 to 127 centimetres and .159 to 3.81 centimetres)
3.5 to 19 inches and 1/8 to 1.25 (8.89 to 48.26 and .3175 to 3.175 centimetres)
40 to 3,000 gallons/minute and 500 to 9,000 psi (151.42 to 11356.24 litres/minute and 34.47 to 620.53 bar)
0 to 500 gallons/minute and 0 to 1,000 psi (0 to 1892.705 litres/minute and 0 to 68.95 bar)
40,000 to 135,000 psi (2757.90 to 9307.92 bar)
1/16 to 1.5 inches (.159 to 3.81 centimetres)
1/8 to 1.25 in (.3175 to 3.175 centimetres)
1.05 to 48 inches (2.667 to 121.92 centimetres)
3 ½ to 19 inches (8.89 to 48.26 centimetres)
2 to 5 feet (.6096 to 1.524 meters)
0 to 9,000 psi (0 to 620.528 bar)
0.125 to 3 inches (.3175 to 7.62 centimetres)
0.25 to 0.75 (0.635 to 1.905 centimetres)
1 to 47 inches (2.54 to 119.38 centimetres)
3.5 to 19 in (8.89 to 48.26 centimetres)
1,200 to 8,500 psi (82.737 to 586.054 bar)

40 to 1250 gallons/minute (151.416 to 4,731.765 litres/minute)
3 to 15.5 inches and 3.5 to 16 inches (7.62 to 39.37 and 8.89 to 40.64 centimetres)
500 to 10,000 psi (34.47 to 689.48 bar)
3/8 to 1 ½ inches and 3 ½ to 16 inches (.9525 to 3.81 and 8.89 to 40.64 centimetres)
0.625 to 0.75 inches and 3 to 19 inches (1.5875 to 1.905 and 7.62 to 48.26 centimetres)
3/8 to 1.5 inches and 3.5 to 16 inches (.9525 to 3.81 and 8.89 to 40.64 centimetres)
5,000 to 20,000 psi (344.737 to 1,378.951 bar)
0.125 to 1.5 inches (.3175 to 3.81 centimetres)

CLAIMS

1. An apparatus, comprising:

a wellbore, the wellbore formed by the process of drilling the wellbore; and

a tubular liner positioned within the wellbore, the tubular liner formed by the process of extruding the tubular liner off of a mandrel while drilling the wellbore with a drill bit coupled to a downhole motor operably coupled to the mandrel.

2. The apparatus of claim 1, wherein extruding the tubular liner off of the mandrel comprises:

injecting a fluidic material into the wellbore.

3. The apparatus of claim 2, wherein the injecting comprises:

injecting a non hardenable fluidic material into an interior region of the tubular liner below the mandrel.

4. The apparatus of claim 3, further comprising:

fluidicly isolating an annular region from the interior region before injecting the non hardenable fluidic material into the interior region.

5. The apparatus of claim 3, wherein the injecting of the non hardenable fluidic material is provided at operating pressures and flow rates ranging from about 500 to 9,000 psi and 40 to 3,000 gallons/min (34.47 to 620.53 bar and 151.42 to 11356.24 litres/minute).

6. The apparatus of claim 3, wherein the injecting of the non hardenable fluidic material is provided at reduced operating pressures and flow rates during an end portion of the extruding.

7. The apparatus of claim 2, wherein the fluidic material is injected below the mandrel.

8. The apparatus of claim 1, wherein a region of the tubular liner below the mandrel is pressurized.

9. The apparatus of claim 8, wherein the region of the tubular liner below the mandrel is pressurized to pressures ranging from about 500 to 9,000 psi (34.47 to 620.53 bar).

10. The apparatus of claim 2, further comprising:

fluidicly isolating an interior region of the tubular liner from an exterior region of the tubular liner.

11. The apparatus of claim 10, wherein the interior region of the tubular liner isolated from the region exterior to the tubular liner by inserting one or more plugs into the injected fluidic material.

12. The apparatus of claim 1, further comprising:

maintaining the mandrel in a substantially stationary position during the extrusion of the tubular liner and the drilling out of the wellbore.

13. The apparatus of claim 1, further comprising:

overlapping the tubular liner with an existing wellbore casing.

14. The apparatus of claim 13, further comprising:

sealing the overlap between the tubular liner and the existing wellbore casing.

15. The apparatus of claim 14, further comprising:

supporting the extruded tubular liner using the overlap with the existing wellbore casing.

16. The apparatus of claim 14, further comprising:

testing the integrity of the seal in the overlap between the tubular liner and the existing wellbore casing.

17 The apparatus of claim 1, further comprising:
lubricating the surface of the mandrel.

18. The apparatus of claim 1, further comprising:
absorbing shock.

19. The apparatus of claim 1, further comprising:
catching the mandrel upon the completion of the extruding.

20. The apparatus of claim 1, further comprising expanding the mandrel in a radial direction.

21. The apparatus of claim 1, further comprising:
drilling out the mandrel.

22. The apparatus of claim 1, further comprising:
supporting the mandrel with coiled tubing.

23. The apparatus of claim 1, wherein the wall thickness of the tubular liner is variable.

24. The apparatus of claim 1, further comprising:
applying a variable axial force to the bottom of the wellbore.

25. An apparatus, comprising:
a wellbore;
a tubular liner positioned within the wellbore;

a non-rotating mandrel coupled to the tubular liner positioned within the wellbore and within the tubular liner; and

a drill bit operably coupled to the tubular liner;

wherein the tubular liner is formed by the process of extruding the tubular liner off of the mandrel while drilling the wellbore using the drill bit.

26 . An apparatus, comprising:

a wellbore;

a tubular liner positioned within the wellbore;

a mandrel positioned within the wellbore and within the tubular liner; and

a drill bit operably coupled to the tubular liner positioned within the wellbore;

wherein the tubular liner is formed by the process of extruding the tubular liner off of the mandrel while drilling the wellbore using the drill bit; and

wherein there is a relative rotation between the mandrel and the drill bit.

27. An apparatus, comprising:

a wellbore;

a tubular liner positioned within the wellbore;

a mandrel positioned within the wellbore and within the tubular liner; and

a drill bit positioned within the wellbore, the drill bit continuously operably coupled to the mandrel;

wherein the tubular liner is formed by the process of extruding the tubular liner off of the mandrel while drilling the wellbore using the drill bit.

28. The apparatus of claim 25, 26 or 27, wherein the mandrel is expandable in a radial direction.

ABSTRACT

An apparatus, comprising: a wellbore, the wellbore formed by the process of drilling the wellbore; and a tubular liner positioned within the wellbore, the tubular liner formed by the process of extruding the tubular liner off of a mandrel while drilling the wellbore.

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